Reinforced Concrete Engineers' Hand-Book

No. S-5.

"Steelcrete" TRADE MARK

STEEL AND RADIATION LIMITED

HEAD OFFICE TORONTO CANADA

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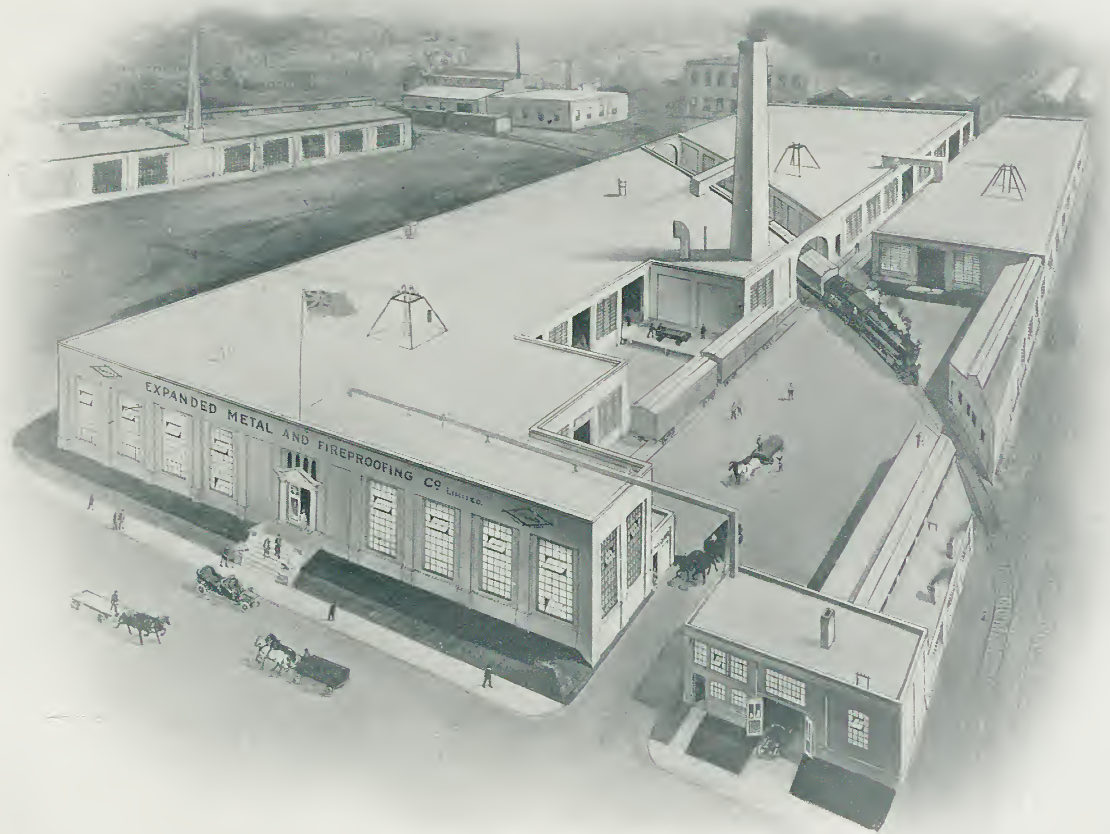
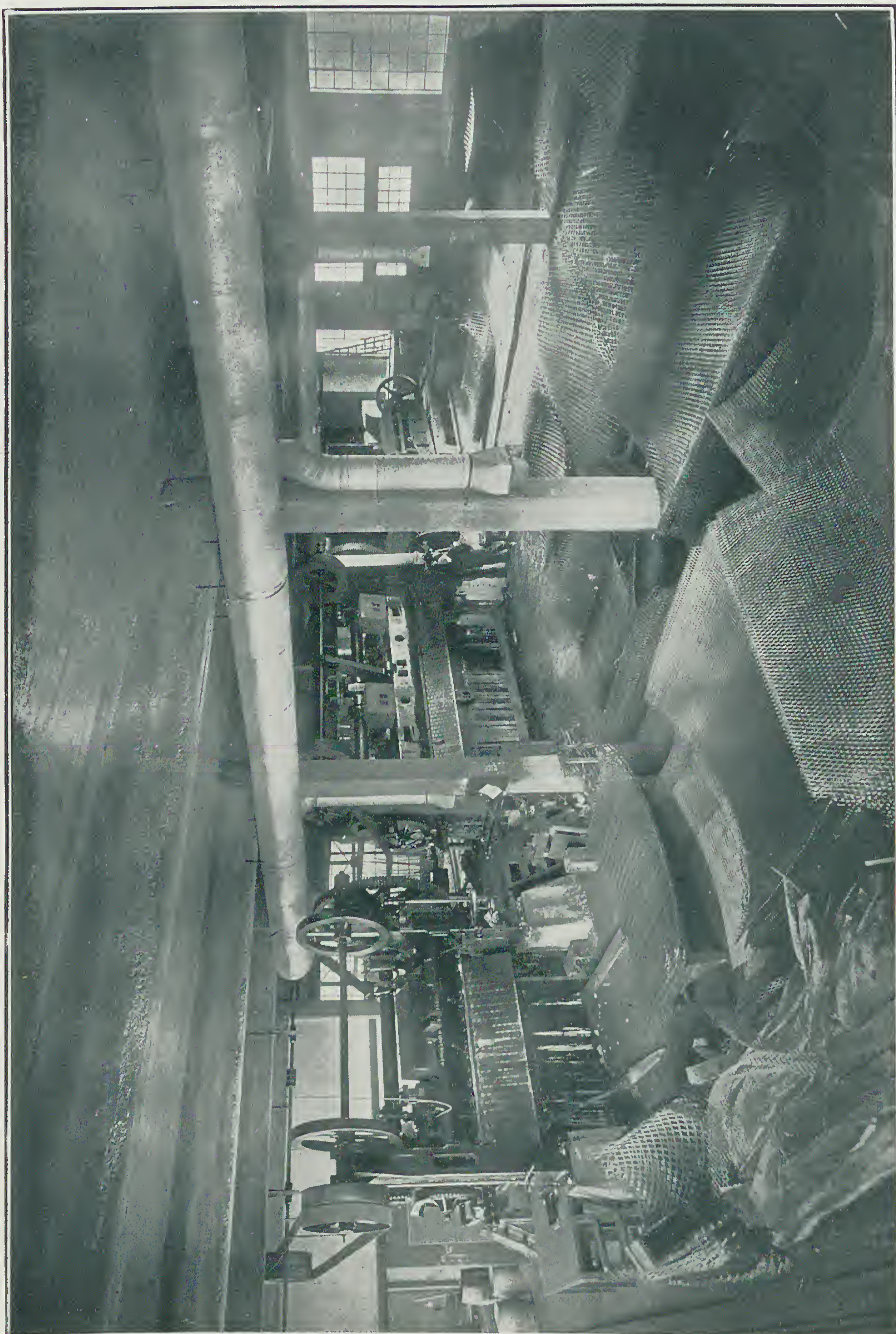

EXPANDED METAL AND FIREPROOFING Co LIMITED

WHERE "STEELCRETE" AND "FENESTRA" PRODUCTS ARE MADE

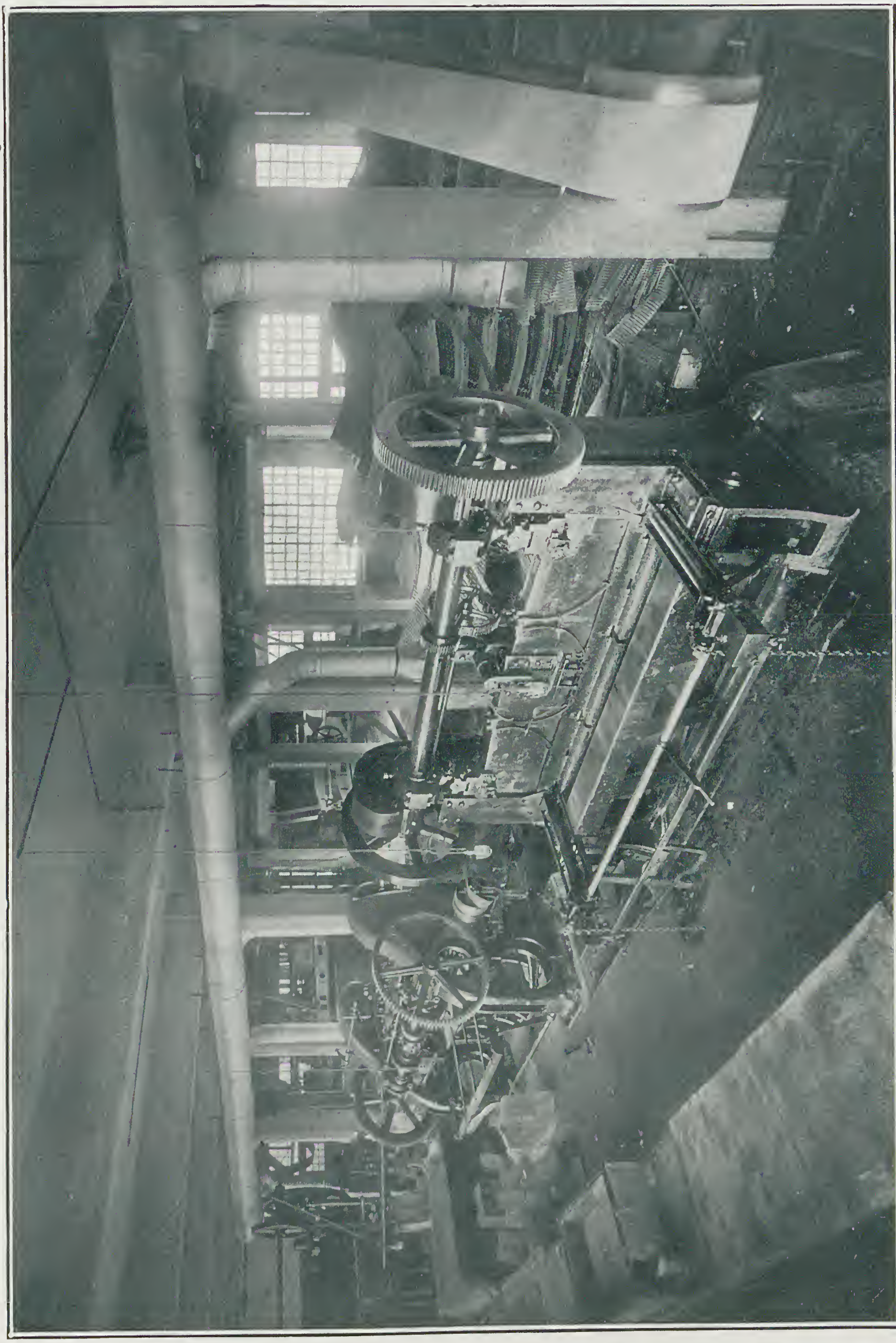
ON the opposite page is shown the immense new Expanded Metal plant of STEEL AND RADIATION, LIMITED, which the large and growing demand for "STEELCRETE" and "FENESTRA" products has made possible and necessary. These buildings are situated at the foot of Fraser Avenue, close to the Canadian National Exhibition Grounds, Toronto. They are built entirely of "STEELCRETE" Reinforced Concrete, "FENESTRA" Steel Sash and Steel, and afford excellent explanations of the reason why "STEELCRETE" and "FENESTRA" products are so wonderfully in demand for the best industrial buildings.

The machinery, all the best and latest of its class, is electrically operated. Exceptional facilities are afforded for the handling of the large volumes of business by the complete transportation systems both of the railroad sidings and those of STEEL AND RADIATION, LIMITED.

Architects, Engineers, Contractors and others interested in high grade fireproof building materials, are always welcome to inspect this establishment. On the following pages we are showing a few of the interesting sections of this large and complete plant.



A Corner of Expanded Metal Department, showing a Battery of Heavy Expanded Metal Machines



Another Battery of Expanded Metal Machines

FOREWORD

THIS MANUAL is compiled for the use of Architects, Engineers, Contractors and all those planning or superintending building. In designing new structures and preparing specifications, it will be found of great assistance. No care nor expense has been spared in its preparation. The best technical literature has contributed to its pages, the tables are the result of exhaustive tests, superintended by competent engineers, and the plans will be found most complete. It is brimful of interesting and valuable construction information. You will find it indispensable at your desk and a ready assistant for the man on the job.

DEVELOPMENT OF REINFORCEMENTS

THE first use of metal for the reinforcement of concrete was by a French gardener in making large vases or urns. The next use of metal with concrete was to secure greater tensional resistance. The use of the combination was then adapted to slabs for floors and then to beams. As this system of construction developed, the need of a mechanical bond between concrete and steel reinforcement became more and more apparent. There are many different bars now on the market, which provide more or less of a mechanical bond between concrete and steel, but there is no better form of reinforcement for slabs than Expanded Metal. The formation of the meshes not only gives a mechanical bond, but in the plane of the metal is a reinforcement in all directions. Referring to figure on page 32 showing a sheet of Expanded Metal imbedded in a slab of concrete, the truth of this statement is apparent.

Expanded Metal is frequently used as a bond between parts of concrete work executed at different times, also as a bond on the surface of massive concrete walls. All concrete sinks in setting, therefore when large areas are covered, cracks are unavoidable unless reinforcement in **two directions** is used. Expanded Metal affords the best form of reinforcement for this purpose.

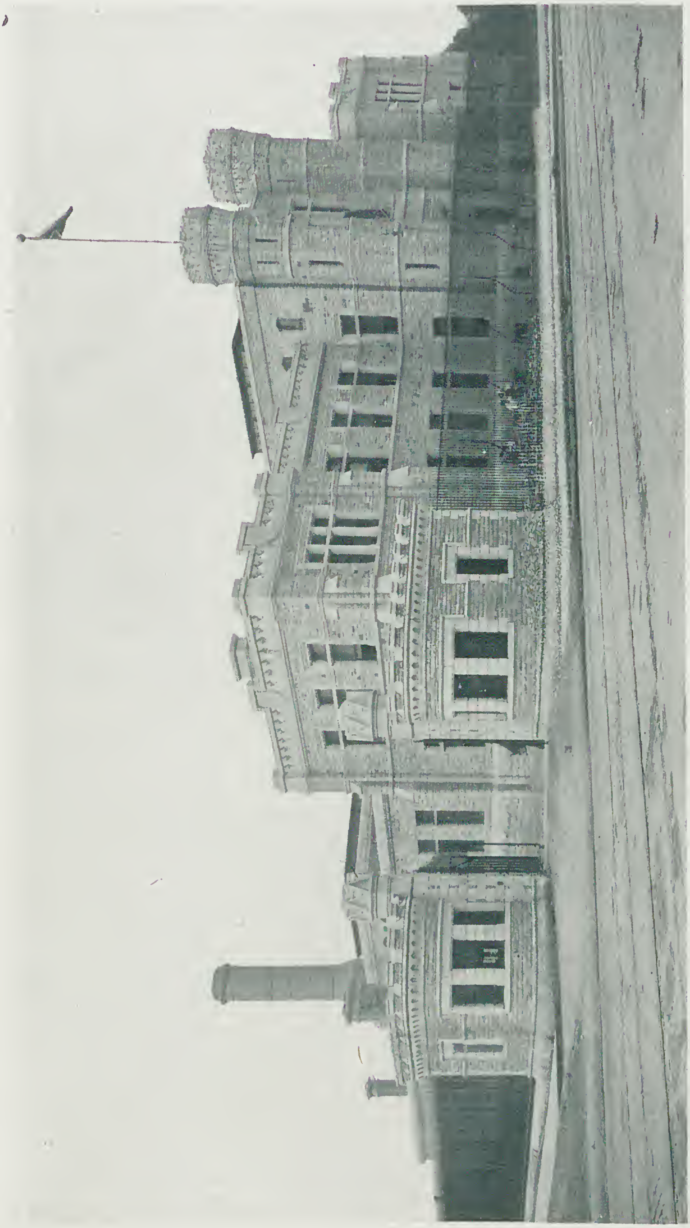
REINFORCEMENT—HOW CHOSEN

When choosing a system of slab reinforcement, the architect or engineer adopts that which, from every standpoint, best suits the particular construction in hand. He considers whether his slabs should have Expanded Metal, rods, deformed bars, or some of the various fabrics manufactured from wire.

Rods, it may be, are the first consideration. They should be properly connected at right angles with cross wires at such frequency that the temperature stresses will be taken care of, and the expansion and contraction of the concrete will not cause the cracks so common in rod-strengthened floors. Rods with no wiring require most rigid and continuous inspection to obtain the spacing designed, and to ensure, when once correctly placed, that the rods retain this proper position, both as to distance apart and relative to the slab thickness. Remember that the concrete laborer knows and thinks less of resisting moments than of his day's pay. Rods with wire spacers are open to the objection that in the haste of actual building, wheelbarrows and men loosen the wiring, no matter how well done. Serious disarrangement can thus result. Too often this disarrangement entirely escapes detection in the bustle and rush of actual building.

Possible concentrated loading of a floor is a contingency which the designer has to hold in view, and in using rods should do so remembering that they only serve the load directly over them, gaining no resistance from the reinforcement on each side. With rod reinforcement there is a practical limit to the possibility of small sections at frequent intervals, which are concededly preferable to larger sections spaced farther apart.

Mesh fabrics of different varieties are also offered. One advantage of this class of reinforcement is that it represents a unit system and the possibility of wrong spacing disappears. The laying of a proper fabric is also more easily, therefore more cheaply, done, as a considerable portion of floor can be covered at once. Obviously, as slabs are thin, **it is important**



THE ROYAL MINT, OTTAWA (A Money-Making-Concern)
Mr. D. Ewart, Architect
"Steelcrete" Expanded Metal Reinforcement and Fireproofing

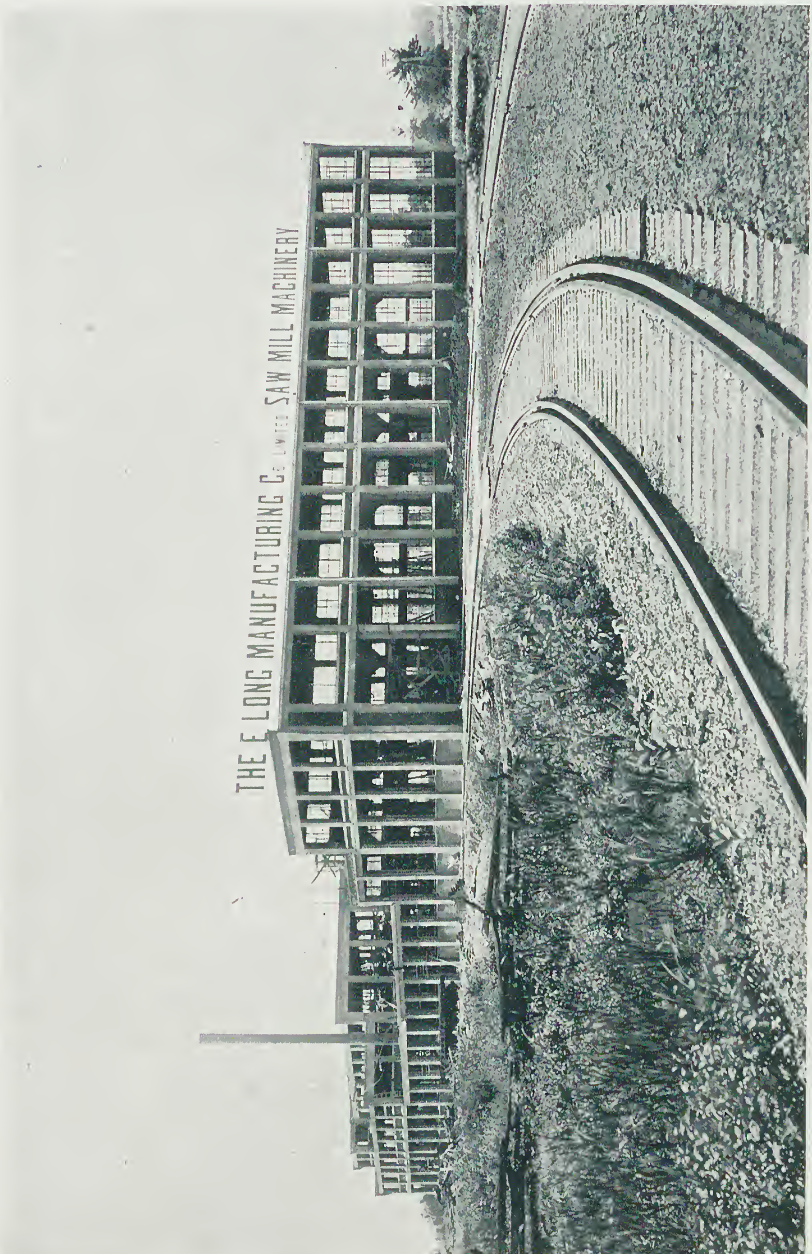
to choose a mesh which will lie flat in its intended position at the bottom of the slab. Too frequently, fabrics which come in rolls, warp badly and are imbedded at the top or compression side of the slab. Designing with a rectangular mesh must be with a view to the fact that the total steel area is not available for reinforcement, so that 1% reinforcement being called for, the designer really required 1⅓% to 1½% when using rectangular mesh or rods that are cross tied. The cross-bonding steel is worthless as anchorage. No matter what shape the mesh happens to be,—square, oblong or diamond—examine closely and reject a material with the junctions or strands of a nature to draw gradually tight as the load goes on. A perfect reinforcing mesh should have no tautening up to invite deflection and permanent set. The joint should be solid, the strand as straight and true as a tie-bar.

REINFORCED CONCRETE IN BUILDINGS

In pace with the awakened prosperity of the Dominion, there has been a steadily increasing demand for a better class of structure for store, office, factory and warehouse purposes. "The Fireproof Building" has come to its own. Four important factors have been responsible: its unyielding strength, absolute permanency, the ever ascending cost of lumber and the desire to keep insurance rates within reasonable bounds.

Manufacturers and owners generally do not lose sight of the fact—let their insurance outlay be what it may—that fireproof construction confers the boon of absolute freedom from apprehension lest a conflagration should happen and cause a stoppage of business, more or less complete. Taking the case of mill construction, the last Toronto fire, in fact, every recent large conflagration on the continent, showed how quickly a fire, under certain conditions, can gallop through a building, however well sprinkled, and land floor after floor of the heavy wood beamed construction in the basement. The columns and beams of a mill structured building lack rigid connection, so that there is comparatively no structural stability. Instead of causing the enforced cessation of business referred to, a modern reinforced concrete structure, with its elevators and stair enclosures of Expanded Metal Lath and Portland Cement mortar, would be standing intact next morning. Upon whatever floor the fire entered or started, it would be confined there by these effectual fire stops, and ready for re-occupation after the insurance adjustment incidental to stock damage or loss. The extra cost of a fireproof concrete building over one of mill construction is only from 5% to 20%.

The framework of such a building is usually of steel columns, steel girders and joists. Steel columns, connected with steel lintels at each floor level, may also be used to carry the outer thin curtain wall. Otherwise, solid brick walls are utilized, all beams and columns throughout fireproofed with concrete, and a three or four inch floor slab is laid between the steel joists. The floor slab is reinforced with Expanded Metal, so that, although light, it possesses great strength. By increasing the area of the steel reinforcement and thickening the slab somewhat, any load can be carried. (The all-concrete type differs from the above in that all the beams and columns are built of concrete, moulded in wood forms and reinforced with steel rods, this work being carried up storey by storey, monolithically with the floors.)



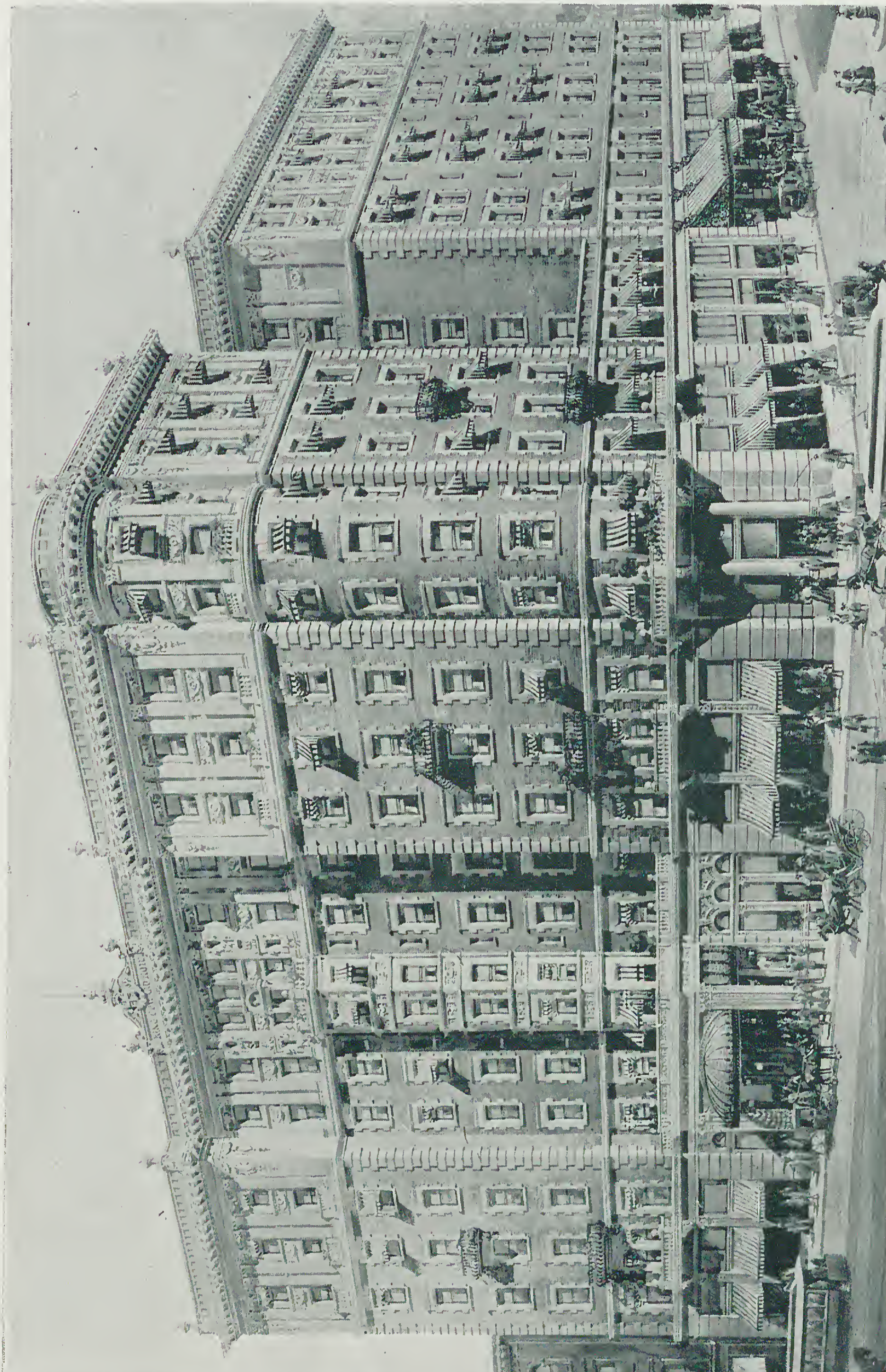
The fine new fireproof plant of The E. Long Manfg. Co., Limited, Orillia, designed by Messrs. Reader & Wood, of Chicago, and built by Messrs. Clarke & Monds, Limited, Toronto. "Steelcrete" Reinforcement, Fireproof Partitions throughout, also "Fenestra" Solid Steel Sash supplying maximum amount of daylight to the interior.

DURABILITY OF REINFORCED CONCRETE

Examples showing the durability of concrete might be multiplied indefinitely. The dome of the Pantheon in Rome, built of concrete nearly 2,000 years ago, a floor in the House of Vestals, and the Aqueduct of Venus are examples of early concrete construction, which are standing to-day. The walls of Reading Abbey appear to have been built of stone with a concrete core. The concrete still remains, although the stone has long since disappeared. The durability of iron imbedded in concrete is attested by iron clamps found in mortar joints in the Pantheon after a period of fully 2,000 years, which were in good condition. Other examples might be cited, where iron has been found in a perfect state of preservation, after an imbedment of hundreds of years.

The preservation of iron in concrete work, depends upon entirely coating the iron with cement, and the best method of obtaining this result is by using a wet mixture. We have previously claimed that Reinforced Concrete is "Rustproof." The term implies not only that the reinforced member as a whole is rustproof, which is self-evident, but also that the concrete coating is the best known protection of steel against corrosion. To show that we are in good company, we desire to outline briefly, the results of the most extensive tests ever made on the subject, and to quote the conclusions of a well-known authority. Professor Norton, of the Massachusetts Institute of Technology, has recently completed the tests referred to, in two series. The first set consisted in imbedding perfectly clean steel in concrete, allowing the concrete blocks to set under the usual conditions of practice, and then subjecting them to various conditions of temperature, moisture, and to carbon-dioxide with traces of sulphurous gases and ammonia. In the second series, specimens of steel, in all degrees of initial corrosion, were similarly treated. Of the latter specimens, Professor Norton says: "The origin of many of the specimens was rather obscure, as the more corroded ones were taken from scrap heaps of steel works, many having been exposed to the weather for several years. Some had been in buildings as part of the structure, some in salt water, some in fresh water, some in damp ground, and the rest exposed to air under various conditions of dampness. The degree of rust on the specimens varied greatly, from a light yellowish stain to a scale more than one-eighth inch in thickness."

"The specimens were of all thicknesses, from 1/50 to 1¼ inches. Some were cut dry, some in water, some with milk-fed oil, and some of those cut with oil were cleaned with gasoline, and others with alkaline solutions, while a third part was left more or less oily. It was intended that the specimens should include everything met with in regular practice. The specimens were imbedded in concrete so as to be covered 1½ inches in all directions. The mixture for some was 1:2½:5 broken stone concrete, and for others 1:3:6 cinder concrete. Part of the specimens, after the concrete had been allowed to set twenty-four hours in air and seven days in water, were placed in a damp cellar, others out of doors, and still others treated in steam and dioxide tanks, called 'corroders'."



The King Edward Hotel, Toronto. Mr. E. J. Lennox, Architect. "Steelcrete" Reinforcement, Lath and Fireproofing.

The specimens were left in the "corroders" from one to three months and subjected to the other conditions from one to nine months. Again Professor Norton states as to the results: "Under these conditions (in the corroders), unprotected steel vanished into a streak of rust, but protected by an inch or more of sound Portland cement concrete, the clean steel was absolutely unchanged. We can now state further, that this same protection is afforded any ordinary structural steel of that degree of cleanliness likely to be found in use for buildings."

"Not one specimen had shown any sensible change in weight or dimensions, except where the concrete had been poorly applied. Some specimens were purposely bedded in very dry concrete, and some in concrete partly set, and many of these were not well covered, and the steel was seriously attacked where there were voids or cracks. Of the hundreds of specimens of rusty steel examined, not one which had a continuous, unbroken coating of concrete, gained or lost anything in volume or weight by treatment which caused the practical destruction of some unprotected specimens. There is one limitation to the whole question and that is the possibility of getting steel properly encased in concrete. Some engineers will have nothing to do with concrete because of the difficulty of getting "sound" work. This is especially true of cinder concrete, where the porous nature of the cinders has led to much dry concrete, many voids and much corrosion. I feel that nothing in this whole subject has been more misunderstood than the action of cinder concrete. We usually hear that it contains more sulphur and this causes corrosion. Sulphur might, if present, were it not for the presence of strongly alkaline cement, but with that present the corrosion of steel by sulphur of cinders in a sound Portland concrete, is the veriest myth, and as a matter of fact, the ordinary cinders, classed as steam cinders, contain only a very small amount of sulphur."

Finally, Professor Norton tersely expresses the gist of the whole subject as follows: "There is one cure and only one—MIX WET AND MIX WELL." We suggest that you cut this out and put it in your hat and all your troubles with "unsound" work will vanish. Wet concrete is not only better, but also cheaper than dry, as the expense of ramming is largely avoided. It must be mixed well and carefully deposited, but the erection of a concrete structure requires no more supervision or skilled labor than the erection of other forms of structure. A steel or wooden frame requires skilled labor and careful supervision during erection, and a flaw in the material or a poor connection will prove just as disastrous as a bit of "unsound" work in concrete structure.

Mr. Shea's New Fireproof Theatre, Toronto. Messrs. Lemp ert & Son, Architects. Mr. E. D. Hoeffeler, Buffalo, Contractor. "Steelcrete" Concrete Reinforcement and Lath were used.

FIRE RESISTANCE

One of the greatest opportunities ever offered to pursue the study of fire resisting materials, was the ruins resulting from the Baltimore fire. It is not our intention to go into the subject further than to give an epitome of the lessons learned, accompanied by references to the most noteworthy reports made after careful examinations of the burned district by the respective authors.

In an address before the National Board of Fire Underwriters at New York on May 12, 1904, Capt. John S. Sewell, Corps of Engineers, U.S. Army, says: "Reinforced concrete in the hands of competent designers and good workmen, is capable of displacing steel entirely for buildings of moderate heights, and of displacing steel girders, beams and floor members everywhere, with improvement in fire-resisting qualities as compared with current types of structures. But it is too early in the day to hope for general acceptance of this view, although there is not the least doubt of its correctness in the minds of those who have given the subject thorough and impartial investigation."

On the same occasion, the well-known consulting engineer, Mr. John R. Freeman, of Providence, R. I., had this to say: "After studying the Baltimore ruins, I am very optimistic on the fire-resisting qualities of Portland cement construction. One great advantage of Portland cement concrete construction is that if you put it in wet and soft, and almost semi-fluid, it will fill the voids and leave no bad "blow-holes" or cavities even under mediocre care and incompetent supervision. The careless workman thus has less chance to get a poor joint than in brickwork. Portland cement concrete possesses far greater tensile strength and shearing strength than the best brickwork, and in brief, I believe that it presents a material for fire-resisting construction which is not excelled by anything yet known."

The following quotations are from Report No. XIII, of the Insurance Engineering Experiment Station at Boston, Mass., of which Mr. Edward Atkinson was Director. The title of the report is "The Conflagration in Baltimore." "Terra cotta has failed. The failure to resist high temperature is due both to the quality of the material itself, which is more or less subject to disintegration under heat and to its expansion. The greater fault is that terra cotta blocks, plates and other forms are detached by expansion in large masses from the steel. When concrete floor arches and concrete steel construction received the full force of the fire, they appear to have stood well, distinctly better than terra cotta. The reasons, I believe, are these: First, because the concrete and steel expand at sensibly the same rate, and hence when heated do not subject one another to stress; but terra cotta usually expands about twice as fast with increase in temperature, as steel, and hence the partitions and floor arches soon become too large to be contained by the steel members which under ordinary temperature properly enclose them. Under this condition the partition must buckle and the segmental arches must lift and break the bonds, crushing at the same time the lower surface member of the tiles. Especially in the Calvert Building, I found evidence which leads

me to believe that not an excessive temperature but the differential expansion under a moderately high temperature of the terra cotta of the top and bottom members and of the enclosing steel is responsible for the general failure of the terra cotta partitions, beam covering and floor arches.

KOHL BUILDING, BALTIMORE, MD.
Expanded Metal Concrete Fireproofing throughout. Partitions on 2nd and 3rd floors slightly damaged, otherwise building remained intact except for damage by smoke.

Secondly, Mr. Gray suggests that there is a similar expansion of the top and bottom faces of the separate tiles, which causes the lower faces to expand and sheer off. Evidences of this were found everywhere."

Further examination of the expansion phenomena points to them as the main source of distress to the whole beam and post covering, floor arches and partitions. Most of the fallen terra cotta partitions and the floor blocks, were still hard and had a clear ring when struck, though cracked and broken. There was no evidence of any such temperature as that at which the terra cotta had been baked originally, and the material of the blocks could not have been altered chemically. It will be readily understood that the thin walled hollow tiles would become heated upon one side much more quickly than would the equivalent area of a solid partition of brick or concrete. Terra cotta, cinder concrete and stone concrete all have about the same heat-absorbing power or specific heat, and hence the heavier and more solid the partition or floor, in other words, the more material there is in it, the slower will be its rise in temperature and its subsequent expansion.

"I question whether any floor, containing so little material on its outer faces as did these hollow blocks, could remain sufficiently cool in this fire to avoid serious injury from expansion."

"The general condition of the fireproof buildings is such as to indicate to my mind the unfitness of terra cotta for beam and post covering, and floor construction as here used, when compared with concrete or brick-work."

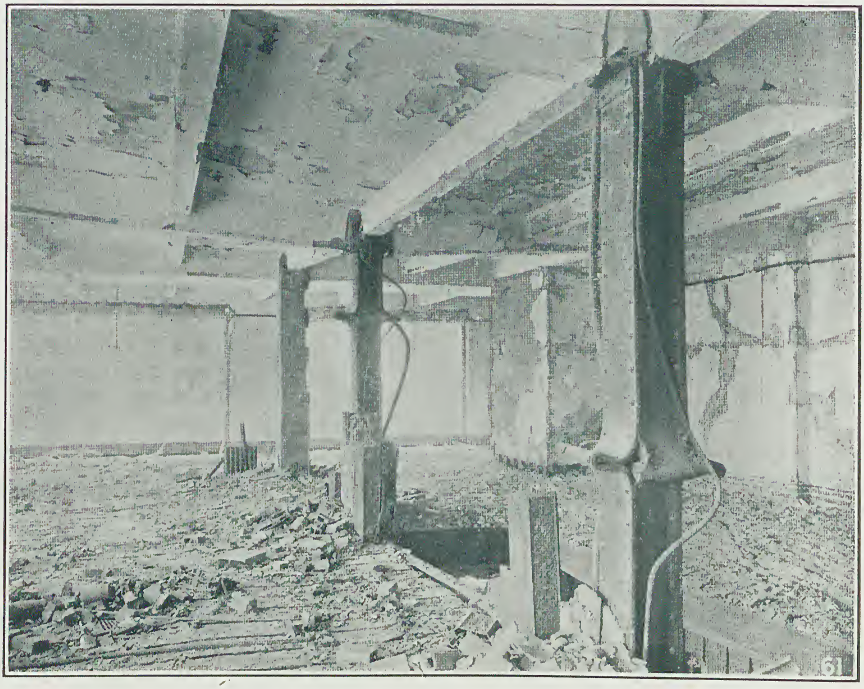
"Much has been said about the uncertainty of concrete. The value of concrete in theory is often admitted by those who consider it unwise to use it because of the difficulty of getting the materials properly proportioned, mixed and placed in position. I have never been able to see the force of this. It is quite as easy to lay sound concrete as it is to put somewhat irregular and confessedly brittle blocks of terra cotta into place with proper bonding. The main difference seems to be that poor concrete reveals its weakness when it falls on 'pulling the centres', while terra cotta is likely to be strong enough to hold itself in position even when it can do little more."

Similar conclusions to those quoted were reached by the Committee of Fire-Resistive Construction of the National Fire Protective Association.

Professor Norton, in reporting on the Baltimore fire says in part: "Further, in the International Trust Company Building, a small paper room having a Hennibique floor and ceiling, was so intensely heated that at the end of three days, the lumps of cast iron were still red hot, and yet neither floor nor ceiling shows sign of distress. This is the more remarkable in that the walls of the adjoining buildings fell through the skylight upon the Hennibique floor. There were, in the Commercial and Farmers' National Bank and in the National Bank of Commerce, concrete floors which stood the fire test well."

The Bullock & Jones Building was constructed of brick and steel. The floors and beams were fireproofed with Expanded Metal and concrete. The partition and column covering was hollow tile. The photograph shows what happened to the columns on the third storey, when the terra cotta fell away. The soffits of beams fireproofed by our Associate Company, and the floors themselves, were entirely uninjured.

The Kohl Building was the most thoroughly fireproofed building in the city. It had Expanded Metal concrete floor arches, double partitions through the corridors and solid partitions, dividing the rooms with cement top finish floors. There were no wood floors in the building. It was the only building in which metal covered trim was used throughout. The elevators and stairs were not encased except in grill work. Slight damage was done to the partitions on the second and third floors, otherwise the building remained intact except for the damage by smoke.



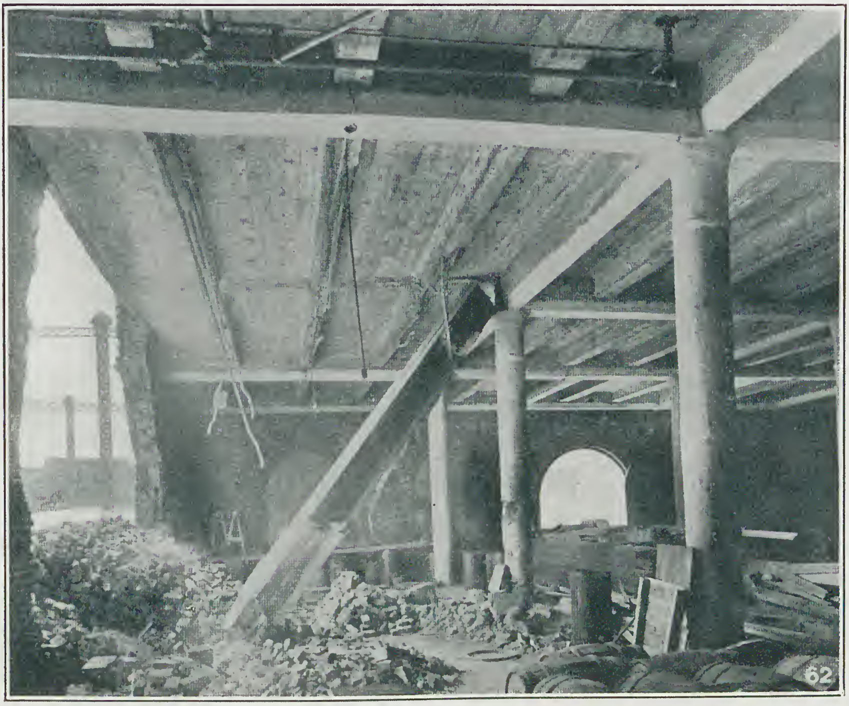
BULLOCK-JONES BUILDING, BALTIMORE, MD.

Expanded Metal Concrete Floors. Hollow Tile Partitions and Column Covering.

The floors of the California Wine Association Building consisted of beams reinforced with bars between the steel girders and over these slabs of Expanded Metal and concrete were built. The girders were 19 feet apart and in turn rested on cast iron column. The heavy wall of an adjoining building broke through the skylight and wall of this building and knocked out one girder beam on each of the upper floors, separating them from the floor arch, but the floor arches themselves were still left standing, as shown in the illustration. This particular instance was one of the best exemplifications of reinforced concrete in the entire city.

In addition to these brief descriptions of instances shown in the illustrations herewith, it may be said that wherever Expanded Metal concrete floors were used, they withstood the shock of the earthquake and fire, the only damage being done in instances like the California Wine Association Building, where walls of adjoining buildings collapsed and fell upon them.

The test of Expanded Metal in the San Francisco disaster was satisfactory in every way. This fact is generally recognized, and as a result, the demand for Expanded Metal is unprecedented.



CALIFORNIA WINE ASSOCIATION BUILDING, SAN FRANCISCO, CAL.

Heavy wall of adjoining building broke through wall of this building and knocked out one girder on each of the upper floors, but the floor arches themselves were left intact. Floor slabs were of concrete and Expanded Metal.

In conclusion, attention is invited to the fact that the reports from which we have quoted were made by men of the highest scientific attainments, none of whom are interested in exploiting any particular fireproofing material or system. On the other hand, they represent the interests of the manufacturers, owners and underwriters, and are therefore, manifestly unbiased in their search for a fire-resisting material that will give the maximum protection and minimum hazard.

RESISTANCE TO VIBRATION

The resistance to vibrations of reinforced concrete buildings, when properly constructed, points to their use as ideal for textile manufacturing plants.

Experiments have been carried on lately at the Austerlitz Station of the Paris and Orleans Railway Company to determine the results of shocks on various floor systems. One floor was constructed of steel beams and brick arches weighing 100 pounds per square foot, and another, constructed of Reinforced Concrete weighing 62 pounds per square foot, both calculated for the same live loads.

On the steel beams and brick arch floor, a load of 112 lbs. dropped 6 feet 6 inches, caused vibrations of 5-16 inch amplitude and lasting two seconds. On the Reinforced Concrete Floor, a load of 220 pounds dropped 13 feet, produced vibrations of 1-16 inch lasting 5-7 of a second. In proportions to the impacts the vibrations of the steel beams and brick arch construction to Reinforced Concrete construction, were 20 to 1 in amount and 11 to 1 in time of duration.

This shows conclusively the superiority of Reinforced Concrete wherever floors are to carry machinery causing vibrations. This superiority is undoubtedly due to the monolithic character of Reinforced Concrete buildings. The floor slabs (or plates) are a part of the beams, and the beams, girders and columns are all one mass. Steel is used wherever there is the slightest chance for the direct loads or the vibration of machinery to form a crack in the construction. By this means the whole building becomes a unit.

In a steel or wood frame building, the beams are not generally rigid at connections, and therefore may vibrate independently of the building as a whole. In Reinforced Concrete construction, the whole building being a unit, assists each part to resist vibrations.

It has lately been shown by tests that concrete will resist indefinitely a certain amount of stress. Therefore, we see no reason why a Reinforced Concrete structure should not last indefinitely.

We advise, however, that work of this character be designed by and erected under the supervision of experienced and reliable men in this class of work.

Accidents sometimes happen in the construction of buildings of any material. In such cases the resulting damage and serious accidents to life and limb often depend upon the ability of the floor to resist shocks. In one instance, a large stone, weighing over 1000 lbs., accidentally dropped nearly 100 feet upon an Expanded Metal floor. The floor withstood the shock and the slight damage to same was easily repaired.

Another instance of this kind occurred recently in the Newark Warehouse. A steel beam weighing 960 lbs. dropped from the roof to the first floor, a distance of about 87 feet. The beam was stopped by the Expanded Metal concrete floor and the damage repaired for about fifty cents.

RESISTANCE TO EARTHQUAKE AND FIRE

The authorities who have examined the ruins of San Francisco, and they have been many, unite in agreeing that Expanded Metal concrete made a record for itself. We quote a few paragraphs from some eminent authorities.

From an article by Chas. Derleth, Jr., Assistant Professor of Structural Engineering at the University of California, who wrote an extended account of the fire in the "Architect and Engineer" of California, under the title of "Structural Lessons from the Earthquake," these few paragraphs are taken. We make this selection from a group of forty-four different notes commenting upon special features.

"Reinforced Concrete should be more respected in the future by the building laws and trade unions of San Francisco. There is no reason why buildings of this type, designed by competent engineers, should not be six or eight storeys in height."

"Reinforced Concrete sewers should be studied in the light of the brick sewer construction, which has been so generally meted out in the made ground of the city."

"Almost invariably, floors and partitions of Reinforced Concrete have withstood the tremulor magnificently, and have shown up excellently in the fire test. By the fire, most all other types of floors have been thoroughly disintegrated. Everywhere in the city, may be seen buildings standing, whose partitions and floors, where intact, prove to be of concrete and reinforced work.

Twenty Years Ago the Best— The Best To-day

A Reinforcement in Readily Handled Sheets

"STEELCRETE"

The Reinforcement for Unskilled Labor Avoids Labor Cost on Job.

A UNIT SYSTEM

EXPANDED METAL IS THE WORLD-WIDE ADJUNCT TO THIN PLATES

Entire Weight per Square Foot Operative

Manufactured from Best Open-hearth Steel Plates

The Automatic Machine Slits and Opens the Meshes Simultaneously from the Cold Sheet, thus increasing the Elastic Limit and the Ultimate Strength

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THE METHOD OF MANUFACTURING IS AN ABSOLUTE TEST OF THE STEEL

Meshes Diamond Shaped   Joints of Meshes Rigid

Strands Not Corrugated or Twisted

NO "STRAIGHTENING OUT" ENSUES WHEN LOAD IS APPLIED TO SPLIT THE CONCRETE BEFORE THE REINFORCEMENT COMES INTO TENSION

EXPANDED METAL LIES FLAT

Required Sectional Area placed precisely as Designed.

Once Placed, Disarrangement is Impossible, as with Rods.

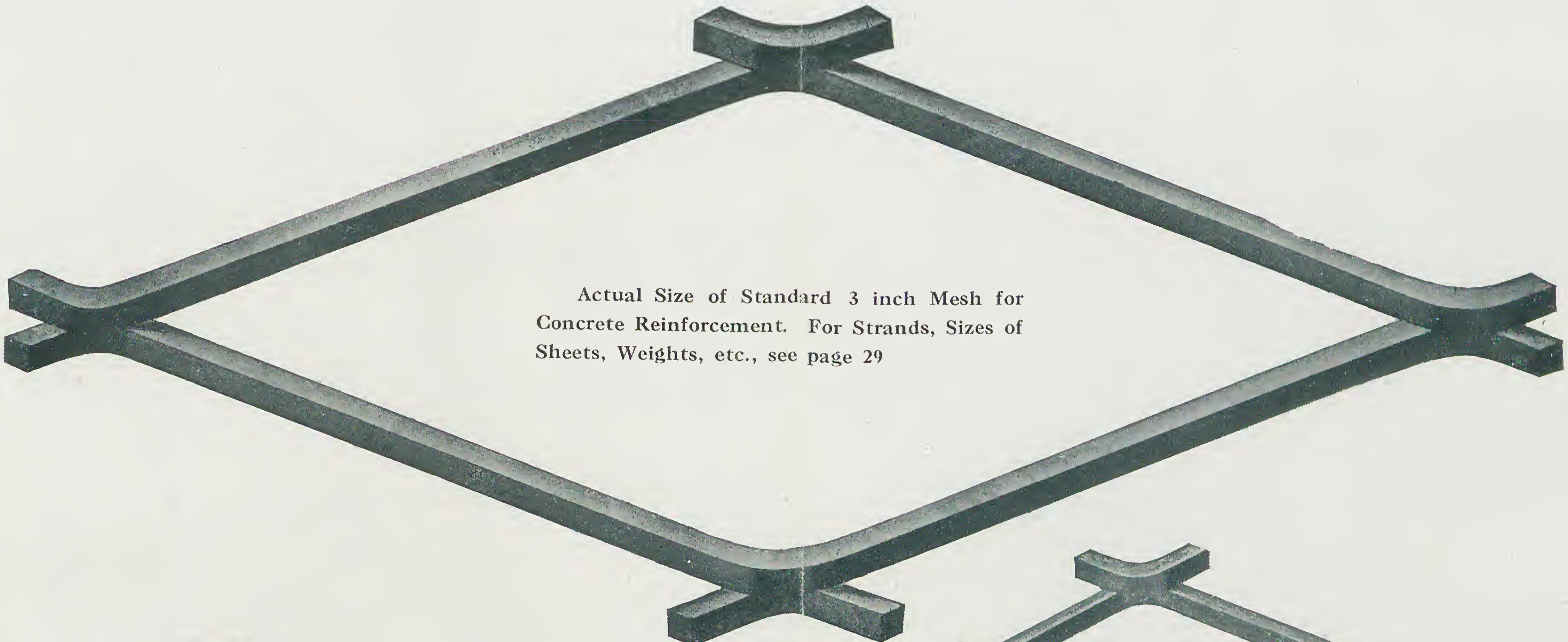
THE EXPERIENCE OF YEARS TEACHES ITS LESSON— NOTHING IS JUST AS GOOD AS

EXPANDED METAL

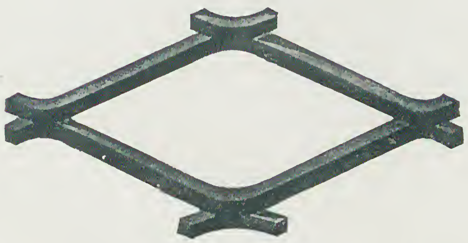
EXPANDED METAL

"AS SHE IS SPOKE"

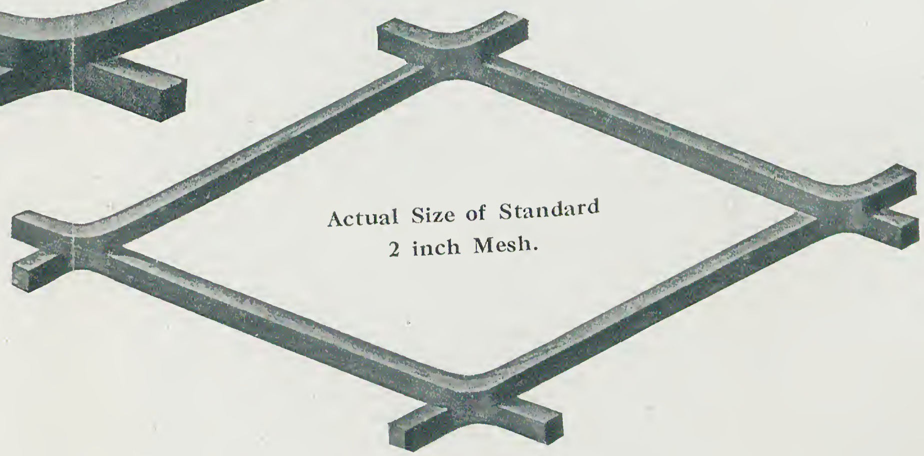
Expanded Metal	English	Streckmetall	German	Tragnetzbleck	Russian
Métal Déployé	French	Traliccio Di Lamiera Stirata	Italian	Metal Desplegado	Spanish



Actual Size of Standard 3 inch Mesh for Concrete Reinforcement. For Strands, Sizes of Sheets, Weights, etc., see page 29

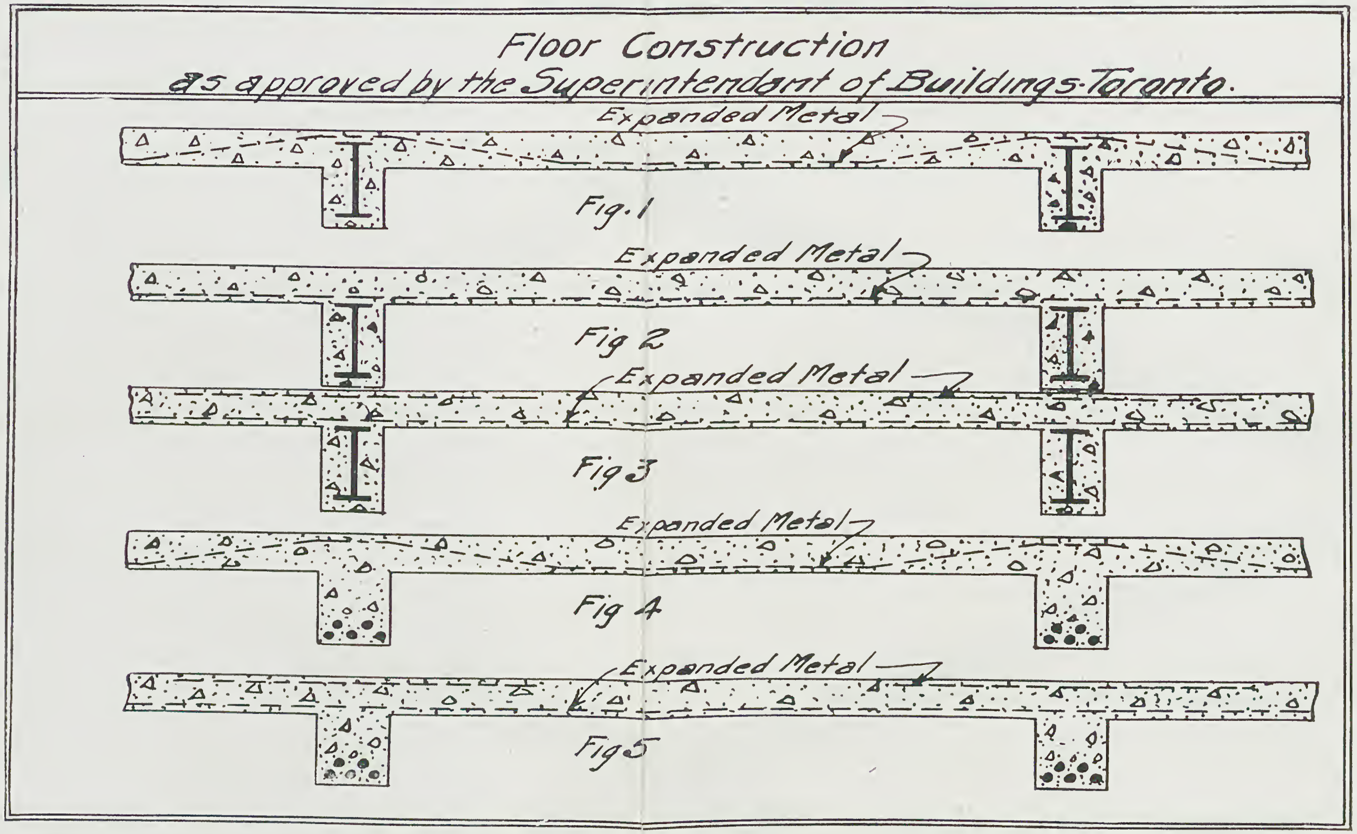


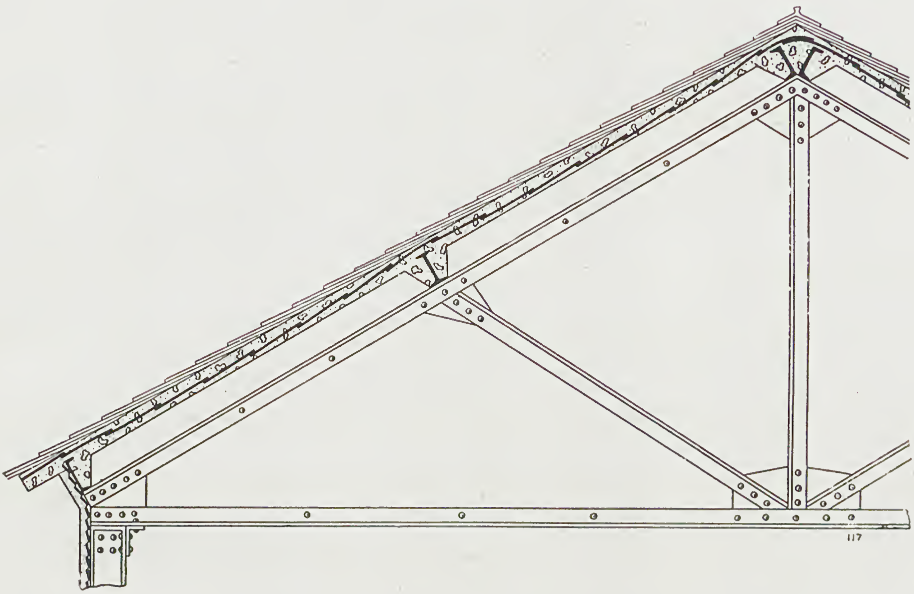
Actual Size of Standard 1 inch Mesh. These small meshes usually used for Screens, Guards, Lockers, etc.



Actual Size of Standard 2 inch Mesh.

TYPICAL "STEELCRETE" REINFORCED FLOORS





SKETCH shows Fig. No. 1 (opposite) applied to a pitched roof. In this method purlins are placed 5 ft. to 8 ft. apart, the slate or other water-proofing materials being nailed directly to the cinder concrete within two or three weeks after placing same. This type of construction is in extensive use in this country and for Canadian climate is found to be much more satisfactory than the lighter forms of concrete roof construction.

IMPORTANT

THOSE who have been accustomed to specifying and handling "Steelcrete" Expanded Metal will note by the accompanying table of physical properties, that we have adopted a new range of standard sectional areas, also a new system of classifying same. The old methods in common use were 3 inch, 10 gauge, light, standard, heavy, extra heavy, etc. This was unintelligible to many and the range of areas was not sufficiently large or uniform.

By our new method we will cut strands of metal in 16, 14, 10, 6 and 4 gauges, varying by 5/100 of a square inch per foot of width from .05 square inch to .60 square inch. We designate these by Plate Numbers which are made up as follows: The first figure denotes the width of mesh, the next one or two figures the gauge, and the next two figures the sectional area. For instance, take Plate No. 31025. This is a 3 inch mesh, 10 gauge material with a sectional area per foot of width of .25 square inch. Or No. 3640: This is a 3 inch mesh 6 gauge material, having an area of .40 square inch.

The standard mesh for concrete reinforcement is 3 inches wide x 8 inches long. The 6 inch mesh is recommended for very large spans and thick slabs and the 1 inch and 2 inch meshes are used only in special slab work, where the concrete mix is very fine, but the greatest use to which these small meshes is put is for screens, guards, lockers, etc., etc.

The engineer in designing is interested mainly in the sectional area of steel. Whether this is made in 16, 14, or 10 gauge metal does not signify, except that in some cases the width of the sheet is important, and this is our reason for cutting and stocking the same sectional area in different gauges and material. By so doing we secure a larger range of widths of sheets. For instance, Plate No. 3630 gives a width of sheet of 4 ft. 9 inches whereas Plate No. 31030, having the same area, gives a width of 6 ft. 10½ inches.

REVISED TABLE OF PHYSICAL PROPERTIES OF

"STEELCRETE" EXPANDED METAL.

Replacing Table, on Page 29, Our Catalogue, "S-5".

Plate Number	Width of Mesh	Gauge of Metal.	Sectional Area per Foot Width.	Weight per Square Foot	SIZE OF SHEET Length	SIZE OF SHEET Width	Sq. Ft. per Sheet
	Inches				Feet	Ft. In.	
x 31015	3	10	.15	.51	12 to 16	6-0	
x 31020	3	10	.20	.68	12 to 16	5-3	
x 31025	3	10	.25	.85	16	4-3	68
x 31030	3	10	.30	1.02	16	6-9	108
x 31035	3	10	.35	1.20	16	5-9	92
x 31605	3	16	.06	.20	8	5-3	42
x 31610	3	16	.10	.34	8	4-6	36
x 31410	3	14	.10	.34	8	5-6	44
x 11615	1	16	.15	.51	8	6-9	54
(o) 3640	3	6	.40	1.36	16	7-1½	114
(o) 3645	3	6	.45	1.53	16	6-3	100
(o) 3650	3	6	.50	1.70	16	5-9	92
(o) 3655	3	6	.55	1.87	16	5-3	84
(o) 3660	3	6	.60	2.04	16	4-9	76

Plate numbers marked (x) are stocked, cut ready to ship.

" " " (o) " " , uncut. Cut to order only.

Width of sheets given are standards, but widths which are even multiples of these can be secured for a small extra charge.

Where length of sheets are given as 12 to 16 ft., the sizes are 12, 14 and 16 ft. Even multiples of these can be secured for a small extra charge.

For meshes and areas other than widths given, apply for special price.

Odd sizes which cut to waste from stock sheets will be charged at price of total material used plus cost of cutting.

STEEL and RADIATION, Limited.

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'ABLE OF PHYSICAL PROPERTIES OF "STEELCRETE" EXPANDED METAL

Plate Jumber	Width of Mesh	Gauge of Metal	Sectional Area	Weight per Sq. Ft.	Width of Sheet		Length of Sheet
	In.				Ft.	In.	Ft.
6420	6	4	.20	.683	8	3	16
6425	6	4	.25	.85	6	6	16
6430	6	4	.30	1.02	5	6	16
6435	6	4	.35	1.193	5	0	16
6440	6	4	.40	1.36	4	3	16
3630	3	6	.30	1.02	4	9	16
3635	3	6	.35	1.20	4	1½	16
*3640	3	6	.40	1.36	7	1½	16
3645	3	6	.45	1.53	6	3	16
*3650	3	6	.50	1.70	5	9	16
3655	3	6	.55	1.87	5	3	16
*3660	3	6	.60	2.04	4	9	16
*31015	3	10	.15	.51	6	6	8 to 16
*31020	3	10	.20	.68	5	3	8 to 16
*31025	3	10	.25	.85	4	3	16
*31030	3	10	.30	1.02	6	9	16
*31035	3	10	.35	1.20	5	9	16
*31415	3	14	.15	.51	7	9	8
*21410	2	14	.10	.34	8	0	8
*21415	2	14	.15	.51	7	6	8
*31605	3	16	.06	.20	5	3	8
*31610	3	16	.10	.34	4	3	8
*11615	1	16	.15	.52	6	9	8
*11620	1	16	.20	.68	4	2	8

Plate Numbers marked thus (*) are stocked. Areas and weights ıer than those specified thus (*) are special and can be had on order.

REMARKS

Widths of Sheets given are standard, but widths which are even ıltiples of these can be secured for small extra charge.

Where length of Sheets are given as 8 ft. to 16 ft., the sizes are 8, 10, 14 and 16 ft. Even multiples of these sizes can be secured for a small ra charge.

Odd sizes ordered which cut to waste from stock sheets will be charged price of total material used plus cost of cutting.

Supplement sheets will be issued when any changes are made.

EXPANDED METALISM

EXPANDED Metal is as familiar to Architects and Engineers, the world over, one might say, as their India ink or their tracing cloth. Expanded Metal is steel, but used with concrete, tests prove it different from other kinds of steel. There are reasons.

The steel and concrete must take up their stresses in concert at all points of a perfect reinforced slab or beam.

Plain rods do this properly only so far as their limited adhesive value permits, and such value depends upon the concrete mix and consistency. Good practice requires something more than adhesion when steel fibre stressing of higher than 16,000 lbs. per square inch is indulged in. A mechanical bond is called for. Again, stress of more than 16,000 lbs. should never be allowed for plain rods, because that limits the safe stress of such rods under stress.

Now, if a high steel stress can be used, the percentage of steel in a plate can be lessened and economy result. Regarding rods, there are two common means contrived to allow of this. First, by deforming the rod; second, by using a rod of high elastic limit. Some rods, such as cold twisted, gain their high elastic limit by the very process of deformation. It is futile to use smooth rods of high elastic limit, because the want of any bond save adhesion makes high stressing a peril.

The Diamond Mesh bids defiance to what is termed the "Fatigue" of Reinforced Concrete. **It cannot slip.**

Perfect Mechanical bond is no misnomer with Expanded Metal. In a building or on a bridge floor, loading partakes more or less of a concentrated nature. The diamond meshes traverse the stresses due to a load, hither and thither in all directions to a considerable distance, switching off continuously in still other directions. The load does not come entirely upon the metal directly beneath it, but is transmitted to other portions, which, themselves unloaded, actually help the loaded area. At such portions, the resistance of the concrete equals the stress in the steel. This is not true of rods, nor so true of other mesh fabrics.

Prof. Rankin's assumption is that the maximum bending stress on a rectangular slab is at the centre, and that there are two principle stresses on plates, these coinciding with the major and minor axis of the slab, or in directions N.S. and E.W. in figure (page 32). The generally accepted reinforced concrete formulæ are deduced on this time honored assumption. The diagonal cracks of Prof. Bach's experiments, however, (see Manual of Reinforced Concrete by Marsh & Dunn, Engl. 1909, pages 91-95) show that the greatest stress is on the diagonal to the axis of the slab corresponding to directions N.W. and N.E. in figure, and that the reinforcement, therefore, should be perpendicular to the diagonals of the rectangle.

The **Strands of Expanded Metal run in two diagonal directions.**

This is another explanation of the surprising results given from tests of slabs reinforced with Expanded Metal. Such results are far in excess of what one is allowed to expect by supplying the sectional area per foot of width as computed by ordinary formulæ.

When the reinforcement runs diagonally, it should not be small wiring to form a mock mesh, but THE MAIN REINFORCEMENT.

Expanded Metal is cut from plates, the expansion effected being from 6 to 12 times the original width of plate. No alteration is made in the length, the strands being consequently somewhat stretched. The stretching being done cold, increases the elastic limit.

The Case in Brief

"Steelcrete" Expanded Metal has the high elastic limit of 48,000 lbs. per square inch, this being 60% of the ultimate strength.

Expanded Metal has a perfect mechanical bond.

Expanded Metal furnishes a uniformly distributed reinforcement, not merely along isolated lines of tension. There is no unreinforced concrete between, over which the load has to arch.

It is axiomatic that small sections close together are better than larger sections farther apart.

In whatever light the above facts are viewed, tests prove that higher stressing values for Expanded Metal should be allowed than for any other style of reinforcement.

Placed Simply—The laborer does not need ability to read plans or use a foot rule.

Placed Quickly—A large area is covered at once without spacing.

Placed Cheaply—Supervision cost is at a minimum.

Placed Correctly—The steel lies flat in the plane of tension, as designed.

Placed Finally—Barrow Wheeling, etc., cannot disarrange.

Rods, when set at correct level above the wood forms, are often pressed down through the concrete. It takes time to readjust them, if detected at all. Often they lie on the sheeting, so that they will remain exposed. It is physically impossible to press Expanded Metal lower, once it has the required thickness of concrete beneath it for fireproofing.

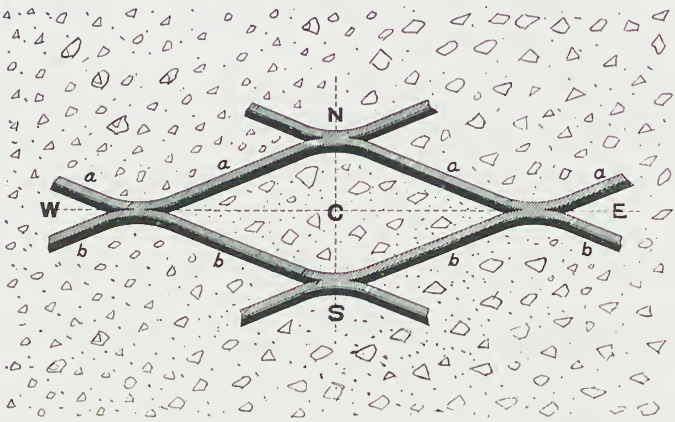
Expanded Metal is not woven. All the joints are rigid and just as strong as any other part of the fabric. The strands are straight and tight and not of a winding or wavy nature that invites a stretch.

When the false work is removed, the strands are taut, instantly ready to exert full tensional effort with application of the load.

Expanded Metal requires no fabrication on the work—The designer is assured that his reinforcement in its exact sectional area, will get its exact position in respect to neutral axis.

All the steel is available for tensile strength.

No Extra steel required for Cross Bond.



Here is a mesh of "Steelcrete" Expanded Metal. Let us examine it.

(a) and (b) are continuous strands running in the span direction as rods would run, except that they zig-zag. The zig-zag gives a continuous anchorage and increases the adhesion in the concrete.

Item—A Mechanical Bond.

The edges of these strands throughout their lengths, are roughened in the cutting.

Item—A Mechanical Bond.

N.S.E.W. Are junction points of adjacent diamonds. Each forms an anchorage for the contiguous strands.

Item—A Mechanical Bond.

C. Is the concrete enclosed within the diamonds. As tension of the steel develops, this concrete being in compression, seizes on the strands with viselike grip and perfects the adhesion.

Item—A Mechanical Bond.

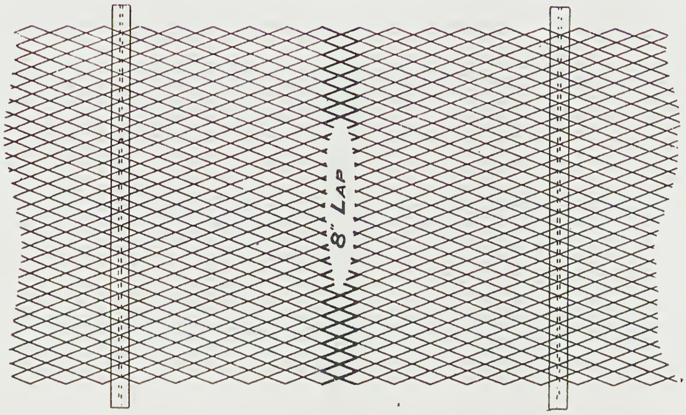
When the steel is highly stressed, the diamond, in stretching lengthwise, tends to compress the concrete in the right angle direction, although on the tension side of the neutral axis, concrete's great resistance to crushing is thus brought into play to aid the tensile member.

Item—A Mechanical Bond.

BUILDINGS HAVE COLLAPSED,
BRIDGES HAVE FALLEN.

To economize in fees of a competent Architect or Civil Engineer, is false economy and sometimes fatal.

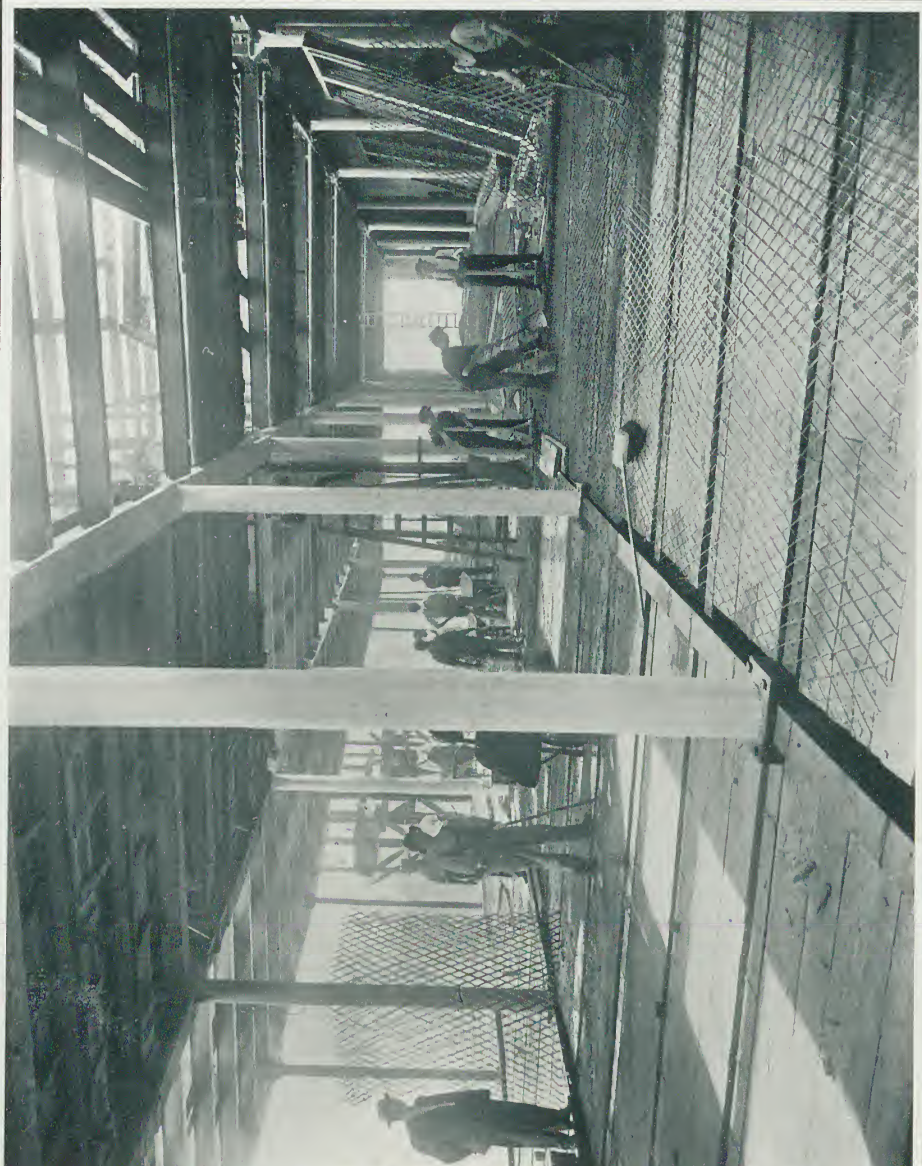
Our Designing Department welcomes correspondence from the Structural Profession, respecting Reinforced Concrete.



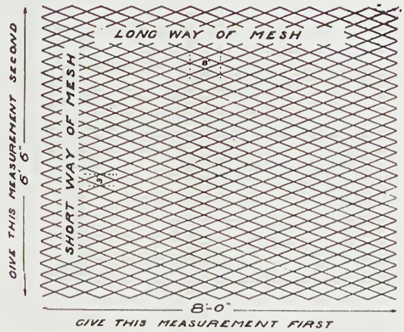
THE SIMPLICITY OF LAYING

Reinforcing steel, if lapped forty times its diameter, develops the full strength of the steel by the adhesion of the enveloping concrete. This is why the fibre stress is transmitted perfectly by lapping the sheets of Expanded Metal one mesh, the length of a mesh to a strand, being in fact, fifty diameters. It is not necessary that this lap should come anywhere in particular **and is quite as well placed in the centre of a bay as over the supports.**

Erect Wood Centering. Lay down layer of concrete to serve as protection to reinforcement on the under side. This may be against gases, fire, or atmospheric influences. Layer varies ordinarily from ½ inch to 1 inch. Where slabs are figured for continuous action over supports, the expanded metal requires raising over the beams to within ¾ inch or 1 inch of top of slab. The best means for this is the preliminary placing of mounds of concrete of the proper depth over the beams; thus, with the thin layer of fireproofing of concrete above referred to, raising the metal about an inch midway between supports, the Expanded Metal, when placed, will naturally assume the proper curve with no further trouble. Lap the sheets one mesh as above. Lay down planks for the barrows on top of the Expanded Metal. Then place the additional concrete to obtain the required full slab thickness. Handling Expanded Metal is simplicity itself. Whoever adopted the word "Foolproof" for Expanded Metal, hit the nail on the head.



"Steelcrete" Expanded Metal being placed on forms. A section of The T. Eaton Co., Limited, Main Store Building.



STOCK SHEETS OF EXPANDED METAL AS IN PREVIOUS TABLES (Page 29) ARE ALWAYS AVAILABLE FOR SHIPMENT

When ordering regular or special sizes of sheets, send us Plate Number, also

1st. Number of Sheets required.
2nd. Size of Sheets required.
3rd. What Mesh required.
4th. What Gauge required.
5th. What Weight per square foot or Sectional Area required.

In furnishing sizes, **always** state **first** the measurement of the sheet, in the long way of the mesh. The sketch herewith of a typical sheet (3 inch mesh, 10 gauge, 8 ft. x 6 ft. 6 inch) explains this clearly, measurements of its diamonds being 8 inches x 3 inches.

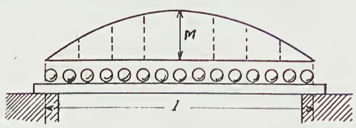
When Ordering Material, remember that the **long** way of the mesh should go **at right angles** to the supports (see page 33). In such cases, it is advantageous for the purchaser to send a rough pencil sketch with measurements, showing the beams and supporting walls. This will eliminate all chance of error as to what should go in the concrete plate.

BENDING MOMENTS

FROM "CAMBRIA" HANDBOOK.

W = Total Load in lbs. Uniformly Distributed including Weight of Beam.
W_1 = Total Super. or Live Ld. in lb's. Unif'ly. Dist.
W_2 = Total Wt. Beam or Dead Ld in lb's Unif'ly Dist.
P, P_1, P_2 = Loads in lbs. Concent'd at Points.
M = Total Bending Moment in inch-lbs.
l = Length of Span in inches.
M_{W1}, M_P = B.M. in inch-lbs. due to Wts. W_1, P.

(1)

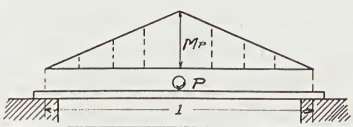


Max. Bend. Moment at Middle of Beam $= M = \frac{Wl}{8} = \frac{(W_1 + W_2)\,l}{8}$

Max Shear at Pts of Supp't. $= \frac{W}{2} = \frac{W_1 + W_2}{2}$

Diagram Total Load = Parabola $M = \frac{Wl}{8}$

(2)



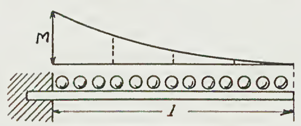
Max. Bend. Moment at Middle of Beam $= M = \frac{Pl}{4} + \frac{W_2 l}{8}$

Max. Shear at Pts. of Support $= \frac{P + W_2}{2}$

Diagram Super. Load = Triangle, $M_P = \frac{Pl}{4}$

Diagram Dead Load = Similar to Case (1)

(3)

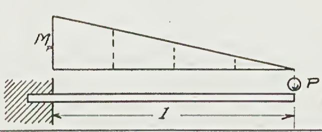


Max. Bend. Moment at Point of Support $= \frac{Wl}{2} = \frac{(W_1 + W_2)\,l}{2}$

Max Shear at Point of Supp't. $= W = W_1 + W_2$

Diag. Total Load = Parabola $M = \frac{Wl}{2}$

(4)



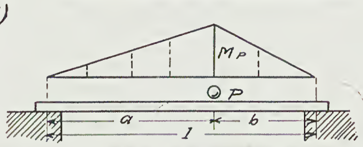
Max Bend. Moment at Point of Support $= Pl + \frac{W_2 l}{2}$

Max. Shear at Point of Support $= P + W_2$.

Diagram Super L'd. = Triangle $M_P = Pl$.

Diag. Dead Load = Similar to Case (3).

(5)



Max. Bend. Moment under Load. $= \frac{a(2Pb + W_2 l - W_2 a)}{2 \times l}$

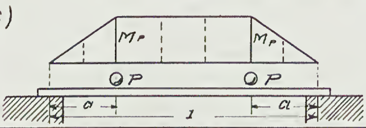
Max. Shear at Sup. near $a = \frac{Pb}{l} + \frac{W_2}{2}$

Max. Shear at Sup. near $b = \frac{Pa}{l} + \frac{W_2}{2}$

Diag. Super. Load = Triangle $M_P = \frac{Pab}{l}$

Diag. Dead Load = Similar to Case (1).

(6)



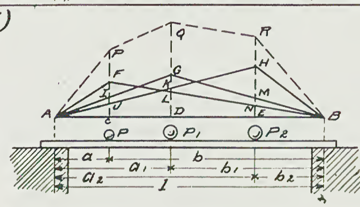
Max. Bend. Moment at Centre of beam $= Pa + \frac{W_2 l}{8}$

Max Shear at Pts. of Support $= \frac{2P + W_2}{2}$

Diag. Super. Load = Trapezoid $M_P = Pa$.

Diag. Dead Load = Similar to Case (1).

(7)



Max. Bend. Moment occurs at Point Where vertical Shear equals Zero.
Let R = Reaction at Left Support.

B.M. at $P = M_P = Ra - \frac{W_2 a^2}{2l}$

B.M. at $P_1 = M_{P1} = Ra_1 - \left[\frac{W_2 a_1^2}{2l} + P(a_1 - a)\right]$

B.M. at $P_2 = M_{P_2} = Ra_2 - \left[\frac{W_2 a_2^2}{2l} + P_1(a_2 - a_1) + P(a_2 - a)\right]$

Shear or Reaction at Left Support $= \frac{P_2 b_2 + P_1 b_1 + Pb}{l} + \frac{W_2}{2}$

Shear or React'n at Right Support $= \frac{P_2 a_2 + P_1 a_1 + Pa}{l} + \frac{W_2}{2}$

Diag'm Super. Load = Triangles as in Case (5) $CJ + CI + CF = CP$
$DL + DK + DG = DQ$, $EN + EM + EH = ER$

Diagram Dead Load = Similar to Case (I)

THEORETICAL DISCUSSION

The natural tendency towards using reinforced concrete formulæ, which are more or less empirical, renders it all the more necessary that the designer should have a clear conception of the underlying principles. His application of short-cut equations will then be correctly made.

The following discussion is made as brief as possible and is derived from results of authentic tests, the recent text books and articles from the technical press.

The word "deformation" will be used instead of strain, as it is lest liable to confuse. The word "stress" will be used to denote the unit resistance to deformation.

The compressive stresses in the concrete of a reinforced concrete beam may be represented by the ordinates to a curve. This curve resembles a portion of a parabola, having its vertex, under working stresses, at some distance above the extreme fibre, and varying only slightly from a straight line. When the ultimate strength of the concrete is developed, the curve approximates a full parabolic curve with the vertex only slightly above the extreme fibre. In this discussion, the modulus of elasticity of concrete in compression is determined from the extreme fibre stress under consideration.

ASSUMPTIONS

A section plane, before bending, remains a plane surface, therefore the deformation of any fibre is proportional to its distance from the neutral axis.

The applied forces are perpendicular to the neutral surface.

The stress of concrete and therefore the modulus of elasticity, are variable factors of its deformation.

The values of the moduli of elasticity, obtained in direct tension and compression, apply to the material under stress in beams.

There is no slipping between the concrete and the metal.

There are no initial stresses in the beam due to the method of construction.

The tensile strength of concrete is negligible.

Let. $M =$ External Bending Moment.

$E =$ Modulus of Elasticity of concrete in compression.

$Ef =$ Modulus of Elasticity of steel.

$C =$ Unit compressive stress in concrete at extreme fibre.

THEORETICAL DISCUSSION—*Continued*

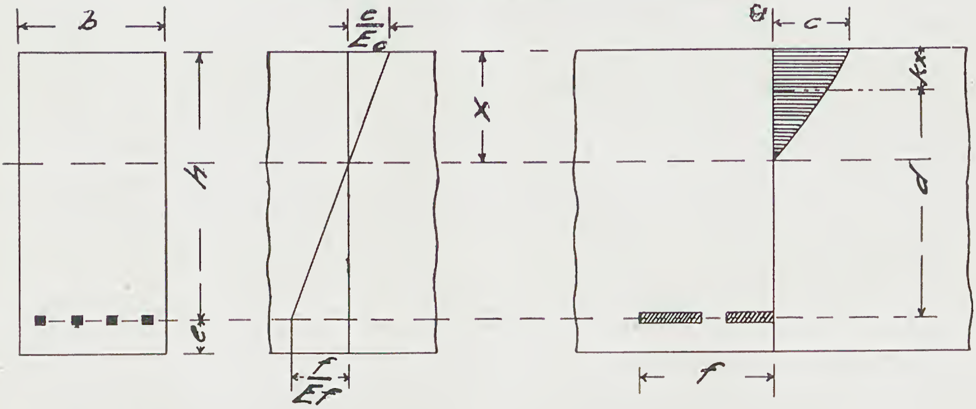


Fig. 1. *Fig. 2.* *Fig. 3.*

Fig. 1 is the cross section of a Reinforced Concrete beam.
Fig. 2 shows the relative deformation of fibre under flexture.
Fig. 3 is the corresponding stress diagram.

Let A = Sectional area of steel in width b.
b = Width of a rectangular beam.
x = Distance from extreme fibre in compression to neutral axis.
kx = Distance from extreme fibre in compression to centre of gravity of compressive stress diagram.

$n = \frac{Ef}{Ec}$

g = Percentage of enclosing rectangle which will be equal to the area of the compressive stress diagram.
gcxb = Total compressive stress in concrete.
fa = Total tensile stress in steel.

Therefore (1) fA = gcxb.

From Fig. 2 by proportion : (2) $\frac{c}{E c}\ x''\ \frac{f}{''Ef} : (h\text{-}x)$.

Equating the values of f from equations (1) and (2) and solving for x gives:

(3) $X = Q\left[-1+\sqrt{\frac{2h}{Q}+1}\right]$ in which $Q = \frac{n\ A}{2\ gb}$

The distance between the centre of gravity of tensile and compressive stress diagram is d, therefore :

(4) $f = \frac{M}{c} \div A.$ (5) $c = \frac{M}{d} \div gxb$

By equations (3), (4) and (5) the stresses in any rectangular beam, reinforced as shown, may be determined.

For designing beams equation (4) may be transposed and written :

(6) $M = f A d$

in which $d = h - kx$ and x is determined by equation (3). In order to avoid overstressing the concrete, $f A$ must not exceed $gc\ x\ b$. A conservative average value of d, and one which has received the general approval of engineers on reinforced concrete, is .86 h, therefore equation (6) may be written—

(7) $M = .86\ h\ f\ A$.

We have in equation (7) therefore, a working formula for the Moment of Resistance, which is reliably safe, and which, in fact is almost in universal use. Having assumed the depth of his beam, it only remains for the designer to get the correct Bending Moment for the case of loading in hand, equate the two Moments and solve for A, taking care that he is not overstressing the concrete. With a stress of 16,000 lbs. per square inch. in the steel, the extreme fibre stress in concrete will not exceed ordinarily accepted working stresses, if the reinforcement does not exceed the following values :

.0045	b h	for	1 : 2½ : 5	cinder concrete.
.007	b h	"	1 : 2 : 4	" "
.009	b h	"	1 : 2½ : 5	stone concrete.
.0122	b h	"	1 : 2 : 4	" "

La Presse, Bldg., Montreal, Messrs. Hutchison & Wood, Architects
"Steelcrete" Reinforcement and Fireproofing.

HOW TO USE TABLES

THE tables found on following pages are based upon equation No. 7, using 16,000 lbs. per sq. inch on the steel, except where the metal exceeds the limiting percentages mentioned in Theoretical Discussion. In these cases the stress in the steel is reduced accordingly and the extreme fibre stress in the concrete is limited as noted. The slabs in these tables are figured as 1:2:4 concrete, weighing 12 lbs. per square foot, per inch of thickness. This weight added to the live or working loads (See Schedule page 43) makes the total load shown in the first column of tables. If special floor finishes are intended, the respective weights of same as shown on page 43 should also be added to the total load. In each table, columns 3, 4, 5, 6, 7, 8 etc., give the required sectional area of steel in square inches per foot of width for each respective slab thickness, total load and clear span.

Up to spans of 10 ft., "Steelcrete" Expanded Metal mesh alone is used most advantageously, but when spans exceed 10 ft., it is advisable to add "Klutch" bars, placed next to the layer of "Steelcrete" Expanded Metal. These bars are placed at such centres as will, together with sectional area of the "Steelcrete" Expanded Metal (see pages 29-73 for areas of "Steelcrete" Expanded Metal and "Klutch" Bars, respectively) provide the total sectional area needed to meet the specified load and factor of safety as shown in tables. Tests show that by this combination of a reinforcement transmitting strains in straight lines only, together with the reinforcement transmitting it diagonally also, a strength is attained far on excess of results looked for from standard accepted formulæ or as developed by other systems of reinforcement.

Our style No. 31610 is second to none as a reinforcement for the fireproofing on structural steel beams, columns, etc., and is being used as such by most of our leading architects and engineers. In specifying and ordering, kindly use Plate Number and avoid mistakes.

TABLES SHOWING AREA OF REINFORCEMENT NECESSARY FOR DIFFERENT LOADS, SPANS AND SLABS

Area of Steel per Ft Width — 3" Slab

Total Load	Live Load	Span in Feet 4	5	6	7	8	9	10
76	40	.047	.074	.106	.144	.189	.239	.295
86	50	.053	.083	.120	.163	.214	.270	.334
111	75	.069	.107	.155	.211	.276	.349	
136	100	.084	.132	.190	.258	.338		
161	125	.099	.156	.225	.306			
186	150	.115	.180	.260				
211	175	.131	.204	.295				
236	200	.146	.228					
261	225	.162	.253					
286	250	.177	.277					
311	275	.193	.302					
336	300	.208						
386	350	.239						
436	400	.271						

$B.M = \frac{wl^2}{10}$

$R.M. = .86 \times 2.25 \times 16{,}000$

Area of Steel per Ft Width — 3½" Slab

Total Load	Live Load	Span in Feet 4	5	6	7	8	9	10
82	40	.042	.065	.094	.127	.166	.210	.260
92	50	.047	.073	.105	.143	.187	.236	.292
117	75	.059	.093	.134	.182	.238	.300	.371
142	100	.072	.113	.163	.221	.288	.364	
167	125	.085	.132	.191	.259	.339		
192	150	.097	.152	.220	.298	.389		
217	175	.110	.172	.248	.337			
242	200	.123	.192	.278	.376			
267	225	.135	.212	.306				
292	250	.148	.232	.334				
317	275	.161	.252	.363				
342	300	.174	.271					
392	350	.199	.311					
442	400	.224	.351					

$B.M = \frac{wl^2}{10}$

$R.M = .86 \times 2.75 \times 16{,}000$

Area of Steel per Ft. Width — 4"-Slab.

Total Load	Live Load	Span in Feet. 6	7	8	9	10	11
98	50	.094	.129	.168	.213	.263	.318
123	75	.119	.161	.211	.268	.330	.400
148	100	.143	.194	.254	.322	.397	.481
173	125	.167	.227	.297	.376	.464	.562
198	150	.191	.260	.340	.430	.531	
223	175	.216	.293	.383	.485		
248	200	.240	.326	.426	.538		
273	225	.264	.359	.469			
298	250	.288	.392				
323	275	.312	.425				
348	300	.336	.457				
398	350	.384					
448	400	.433					

$B.M = \frac{wl^2}{10}$

$R.M = 86 \times 3.25 \times 16000$

Area of Steel per Ft. Width — 4½" Slab.

Total Load	Live Load	Span in Feet 6	7	8	9	10	11
104	50	.087	.119	.155	.196	.242	.293
129	75	.108	.147	.192	.243	.300	.364
154	100	.129	.176	.229	.290	.358	.435
179	125	.150	.204	.266	.337	.416	.505
204	150	.171	.233	.303	.384	.475	.575
229	175	.192	.261	.341	.432	.533	.645
254	200	.213	.290	.378	.478	.591	
279	225	.234	.318	.415	.535		
304	250	.254	.347	.452	.572		
329	275	.275	.375	.489			
354	300	.296	.404	.527			
404	350	.338	.461				
454	400	.380	.518				

$B M = \frac{wl^2}{10}$

$R M = 86 \times 3.75 \times 16000$

Area of Steel per Ft Width — 5"-Slab

Total Load	Live Load	Span in Feet. 6	7	8	9	10	11	12
110	50	.081	.110	.144	.183	.226	.274	.325
135	75	.100	.136	.177	.224	.277	.336	.399
160	100	.118	.161	.210	.266	.328	.398	.474
185	125	.137	.186	.243	.308	.380	.460	.547
210	150	.155	.211	.276	.349	.432	.523	
235	175	.174	.236	.309	.391	.483		
260	200	.192	.261	.342	.432	.534		
285	225	.211	.287	.374	.474			
310	250	.229	.312	.407	.515			
335	275	.248	.337	.440	.557			
360	300	.266	.362	.473	.598			
410	350	.303	.412	.539				
460	400	.340	.462	.605				
560	500	.414	.563	.736				
660	600	.488	.664					

$B.M. = \frac{wl^2}{10}$

$R.M. = 86 \times 4.25 \times 16000$

Area of Steel per Ft. Width — 5½"-Slab.

Total Load	Live Load	Span in Feet. 6	7	8	9	10	11	12
116	50	.076	.104	.136	.173	.214	.258	.306
141	75	.093	.127	.166	.210	.259	.314	.373
166	100	.110	.150	.195	.247	.305	.370	.438
191	125	.126	.172	.225	.284	.351	.426	.505
216	150	.143	.195	.254	.322	.397	.482	.571
241	175	.159	.218	.283	.359	.443	.538	
266	200	.176	.240	.313	.396	.489	.593	
291	225	.192	.262	.342	.433	.535		
316	250	.209	.285	.372	.470	.580		
341	275	.226	.308	.402	.508	.626		
366	300	.242	.330	.431	.545			
416	350	.275	.375	.489	.620			
466	400	.308	.420	.548				
566	500	.374	.510	.666				
666	600	.440	.600					

$B M. = \frac{wl^2}{10}$

$R M. = .86 \times 4.75 \times 16000$

Area of Steel per Ft Width. — 6"-Slab.

Total Load	Live Load	Span in Feet. 8	9	10	11	12	13	14	15
122	50	.129	.164	.202	.245	.292	.343	.396	.456
147	75	.156	.197	.244	.296	.351	.413	.478	.550
172	100	.183	.231	.286	.346	.411	.483	.560	.643
197	125	.209	.265	.327	.396	.471	.554	.640	
222	150	.236	.298	.368	.446	.531	.624		
247	175	.262	.332	.410	.497	.590			
272	200	.289	.366	.451	.547	.650			
297	225	.315	.400	.494	.597				
322	250	.342	.433	.535	.648				
347	275	.369	.466	.576					
372	300	.395	.500	.618					
422	350	.448	.566	.700					
472	400	.501	.634						
572	500	.607	.770						
672	600	.714	.904						

$B.M. = \frac{wl^2}{10}$

$R.M. = .86 \times 5.25 \times 16000$

Area of Steel per Ft. Width — 6½"-Slab

Total Load	Live Load	Span in Feet 8	9	10	11	12	13	14	15
128	50	.124	.157	.194	.235	.279	.328	.380	.437
153	75	.148	.188	.232	.281	.334	.392	.454	.522
178	100	.173	.219	.270	.327	.389	.456	.528	.607
203	125	.197	.250	.308	.372	.443	.520	.603	.693
228	150	.221	.280	.346	.418	.498	.585	.677	
253	175	.246	.311	.384	.464	.553	.650		
278	200	.270	.342	.422	.510	.606	.714		
303	225	.294	.372	.460	.556	.662			
328	250	.318	.404	.497	.602	.716			
353	275	.343	.434	.536	.648				
378	300	.367	.465	.574	.694				
428	350	.416	.527	.650					
478	400	.465	.588	.726					
578	500	.561	.710						
678	600	.658							

$B.M. = \frac{wl^2}{10}$

$R.M. = .86 \times 5.75 \times 16000$

TABLES SHOWING AREA OF REINFORCEMENT NECESSARY FOR DIFFERENT LOADS, SPANS AND SLABS

Area of Steel per ft of Width — 7" Slab — d=6"

Total Load	Live Load	Span in Feet 8	9	10	11	12	13	14	15	16	17
134	50	.124	.158	.195	.236	.280	.330	.382	.438	.498	.563
159	75	.148	.187	.231	.280	.332	.391	.453	.520	.592	.668
184	100	.171	.216	.268	.324	.384	.452	.524	.602	.684	.773
209	125	.194	.245	.304	.368	.436	.514	.595	.683	.778	
234	150	.218	.275	.340	.412	.489	.575	.667	.765		
259	175	.241	.305	.377	.456	.541	.636	.738			
284	200	.264	.334	.413	.500	.594	.698				
334	250	.311	.393	.486	.588	.698	.821				
384	300	.357	.451	.558	.676	.803					
434	350	.404	.510	.632	.764						
484	400	.450	.568	.705							
584	500	.543	.686								
684	600	.636	.804								
784	700	.728	.922								
884	800	.821									

$B.M. = \frac{wl^2}{10}$

R.M. = .86×6×16000

Area of Steel per ft of Width — $7\frac{1}{2}$" Slab — $d=6\frac{1}{2}$"

Total Load	Live Load	Span in Feet 8	9	10	11	12	13	14	15	16	17
140	50	.120	.152	.188	.228	.271	.318	.368	.420	.481	.544
165	75	.142	.179	.222	.268	.318	.375	.434	.498	.566	.640
190	100	.163	.206	.255	.309	.367	.432	.500	.574	.653	.736
215	125	.185	.234	.289	.350	.415	.488	.566	.650	.738	.835
240	150	.206	.261	.322	.390	.463	.545	.632	.725	.825	
265	175	.228	.288	.356	.431	.512	.602	.698	.801		
290	200	.249	.315	.389	.472	.560	.659	.763			
340	250	.292	.369	.456	.553	.656	.772				
390	300	.335	.424	.524	.634	.753					
440	350	.378	.478	.591	.715	.850					
490	400	.421	.533	.658	.796						
590	500	.507	.641	.793							
690	600	.593	.750								
790	700	.679	.858								
890	800	.764									

$B.M. = \frac{wl^2}{10}$

R.M. = .86×6.5×16000

Area of Steel per ft. of Width — 8" Slab — d= 7"

Total Load	Live Load	Span in Feet 6	7	8	9	10	11	12	13	14
346	250	.155	.212	.276	.349	.432	.523	.622	.729	.845
396	300	.177	.242	.316	.400	.493	.598	.712	.834	
446	350	.200	.273	.355	.450	.555	.673	.801		
496	400	.222	.303	.395	.500	.618	.749	.892		
596	500	.267	.364	.475	.601	.743	.900			
696	600	.312	.426	.555	.703	.866				
796	700	.357	.486	.635	.803					
896	800	.402	.548	.714	.904					
996	900	.446	.608	.794						
1096	1000	.492	.670	.874						

$B.M. = \frac{wl^2}{10}$

R.M. = .86×7×16000

Total Load	Live Load	Span in Feet 12	13	14	15	16	17	18	19	20
146	50	.262	.308	.356	.408	.466	.525	.590	.657	.727
171	75	.307	.360	.417	.478	.546	.615	.690	.770	.852
196	100	.352	.413	.478	.548	.625	.705	.792	.882	
221	125	.397	.465	.539	.619	.705	.795	.893		
246	150	.442	.518	.600	.689	.785	.885			
271	175	.486	.570	.661	.759	.863				
296	200	.531	.624	.722	.829					
346	250	.621	.728	.845						

Area of Steel per ft of Width — 9" Slab

Total Load	Live Load	Span in Feet 6	7	8	9	10	11	12	13	14
358	250	141	192	250	316	391	473	562	661	766
408	300	161	218	285	361	445	540	641	754	875
458	350	180	245	320	405	500	606	720	846	981
508	400	200	272	355	448	554	672	798	938	
608	500	239	325	424	537	664	804	955		
708	600	278	378	495	625	773	935			
808	700	318	432	564	713	881	1.067			
908	800	357	485	634	801	990				
1.008	900	396	539	704	890	1.100				
1.108	1000	435	592	774	979					
1.308	1200	514	700	914	1.154					
1.508	1400	592	806	1.050	1.33					

$BM = \frac{wl^2}{10}$

R.M. = 86×8×16000

Total Load	Live Load	12	13	14	15	16	17	18	19	20
158	50	284	292	338	388	441	498	558	622	689
183	75	287	338	392	449	511	577	646	721	798
208	100	326	384	445	510	581	655	735	818	907
233	125	366	430	499	572	650	735	824	916	1.015
258	150	405	476	552	634	720	814	911	1015	
283	175	444	572	606	695	790	892	1.000		
308	200	483	568	659	756	860	970			
358	250	562	661	766	879	1000				

Area of Steel per. Ft Width. — 10"-Slab (Part-I.)

Total Load	Live Load	Span in Feet. 8	9	10	11	12	13	14	15	16
220	100	·136	·173	·213	·258	·308	·361	·417	·480	·546
245	125	·152	·192	·238	·288	·340	·402	·465	·535	·608
270	150	·168	·212	·262	·317	·377	·443	·513	·589	·670
295	175	·183	·232	·286	·346	·413	·483	·560	·644	·733
320	200	·198	·251	·310	·376	·447	·525	·608	·698	·794
370	250	·229	·290	·359	·435	·517	·606	·703	·807	·918
420	300	·261	·330	·407	·493	·587	·689	·798	·916	1·042
470	350	·291	·369	·456	·552	·657	·771	·893	1·025	1·166
520	400	·322	·408	·504	·611	·727	·854	·988	1·135	1·290
620	500	·384	·486	·601	·728	·866	1·016	1·178	1·352	1·540
720	600	·446	·565	·698	·845	1·006	1·180	1·370	1·570	1·788
920	800	·570	·723	·893	1·080	1·287	1·510	1·750	2·010	
1·120	1000	·694	·880	1·087	1·315	1·565	1·838			
1320	1200	·818	1·036	1·280	1·550					
1520	1400	·943	1·191	1·473	1·785					

Area of Steel per Ft. of Width. — 10"-Slab (Part II)

Total Load	Live Load	Span in Feet. 17	18	19	20	21	22	23	24	25
170	50	·477	·534	·595	·660	·727	·800	·871	·949	1·030
195	75	·547	·613	·683	·756	·834	·916	1·000	1·088	1·180
220	100	·617	·691	·770	·854	·940	1·033	1·128	1·228	1·333
245	125	·687	·770	·857	·951	1·045	1·150	1·255	1·370	1·485
270	150	·757	·848	·945	1·048	1·163	1·270	1·383	1·505	1·635
295	175	·827	·927	1·030	1·143	1·260	1·388	1·510	1·645	1·787
320	200	·897	1·006	1·120	1·240	1·368	1·504	1·640	1·785	
370	250	1·037	1·162	1·295	1·435	1·580	1·740			
420	300	1·178	1·320	1·470	1·630	1·793				
470	350	1·318	1·477	1·643	1·825					

$B.M. = \frac{wl^2}{10}$

R.M. = ·86 × 9 × 16000

HANDY TABLES FOR THE DESIGNER

Allowable Floor Loads—Lbs. per Sq. Ft.

	lbs.
Dwellings, Apartments, Hotels, etc.	60
Porches	70
Sidewalks	300
Office Buildings, 1st floor	100–150
Office Buildings, Upper Floors	75–100
Schools, Academies	75
Churches, Halls, Public Buildings	125–150
Stores, Light Mfg., Light Storage	100
Stores, Warehouses, Factories	150–300
Gymnasiums, Dance Halls	125
Stables	150
Garages	150
Roofs, pitch under 20°	40
Roofs, pitch over 20°	30

Weight of Building Materials—Lbs. per Sq. Ft.

	lbs.
Pine or Hemlock (dry) per ft. B.M.	2.5
Pine or Hemlock (green) per ft. B.M.	4
Yellow Pine (Southern)	4.5
Yellow Pine (Northern)	4
Tiles (plain)	15
Wood Lath and Plaster (1 side)	6
⅞ Flooring	3
2 x 4 inch nailing strips at 16 inch centres with 2 inch Cinder Concrete Filling	8.5
Rubber Tiling	1–3
¾ inch Wood Ceiling	2.5
Corrugated Iron Ceiling	1
Stamped Steel Ceiling	2
"Steelcrete" Expanded Metal Lath and Plaster Ceiling	8–10
Plastering (as on concrete ceiling)	5
Slate 3-16 inch thick	7.25
Slate ¼ inch thick	9.6
Copper Sheets	1.5
Tin with Felt, 1 ply	1
Felt and Gravel, 5 ply	6
Felt and Gravel, 4 ply	5.5
Ready Roofing, 3 ply	1
Sheathing 1 inch thick, pine or Hemlock	3
Sheathing 1 inch thick, Yellow Pine	4
2 inch Solid "Steelcrete" Partition, Unplastered	1.50
Add for Plaster per sq. ft	10.00
3 inch Hollow "Steelcrete" Partition per sq ft	1.66
4 " " " " "	1.88
6 " " " ' "	2.55

Add for Plaster 4.5 lbs. per sq. ft. on each side.

2 inch Terra Cotta Tile Furring, Unplastered	8

HANDY TABLES FOR THE DESIGNER—*Continued*

	lbs.
3 inch Terra Cotta Tile Partition, Unplastered	16
4 inch Terra Cotta Tile Partition, Unplastered	19
5 inch Terra Cotta Tile Partition, Unplastered	22
6 inch Terra Cotta Tile Partition, Unplastered	25
8 inch Terra Cotta Tile Partition, Unplastered	33

Add 6 lbs. per sq. ft. for plaster on each side.

9 in. Brick Wall, 84 13 in Brick Wall, 121 18 in. Brick Wall, 168 lbs.
22 inch Brick Wall..... 205 lbs. 26 inch Brick Wall..... 242 lbs.

Weight of Concrete in Lbs. per Sq. Ft. for 1 in. Thickness

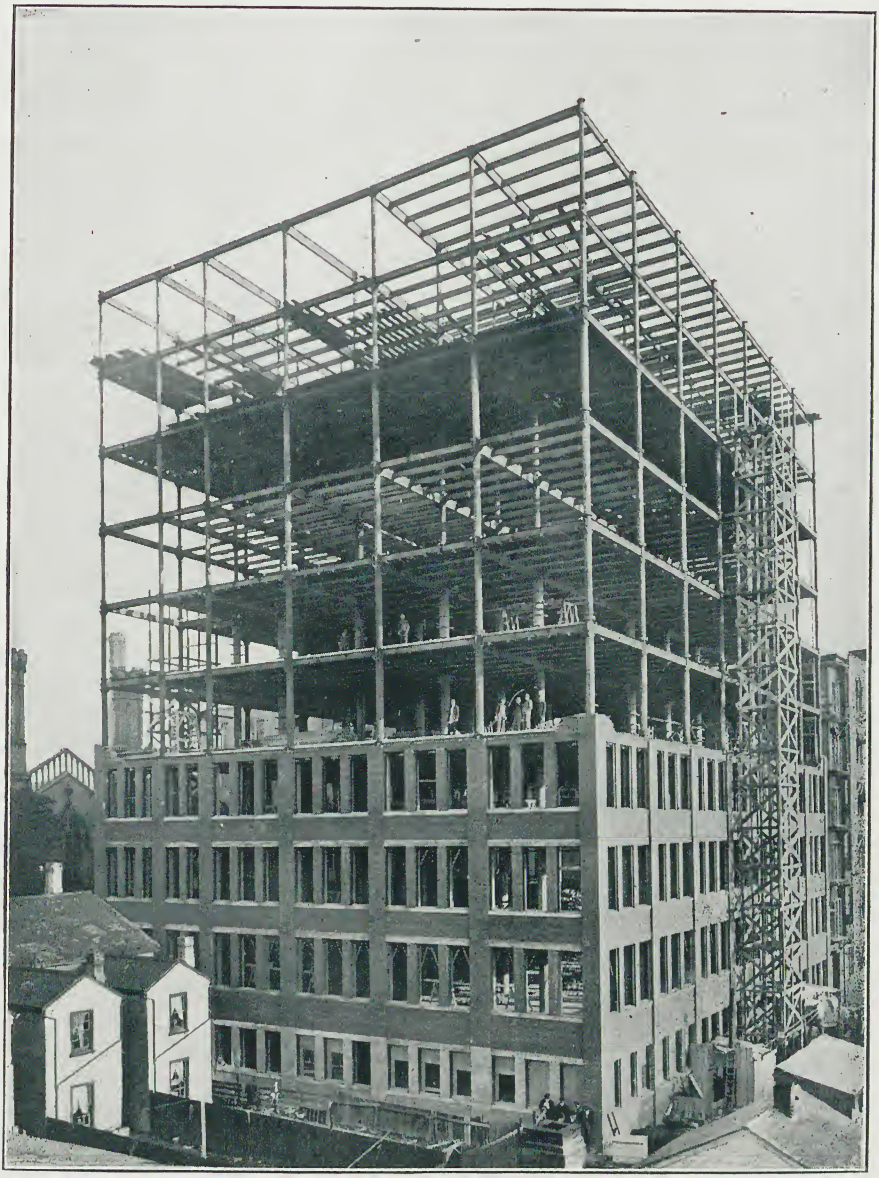
Cinder Concrete..8¼ Crushed Stone..11⅔ Gravel..12½ Slag..11¼

Allowable Safe Loads on Brick or Stone Work, etc., Tons per Sq. Ft.

Kiln run Brick, Lime Mortar	3
Ordinary Brick, Cement Mortar	5
Hard Brick, Lime Mortar	6
Hard Brick, Cement and Lime Mortar	9
Hard Brick, Cement Mortar	12
Pressed Brick, Lime Mortar	8
Pressed Brick, Cement Mortar	14
Rubble Stonework, Lime Mortar	4
Rubble Stonework, Lime and Cement Mortar	6
Rubble Stonework, Cement Mortar	8
Concrete—1:2:5 stone	15

Building Materials, etc., Weight per Cu. Ft. in Lbs.

Anthracite Coal	85–100	Granite, rubble masonry	140
Anthracite Coal, broken	50–55	Gravel, in bank	115
Asphaltum, paving	100	Gravel, dry	74
Bituminous Coal	80	Ice	575
Bituminous Coal, broken	50	Limestone	168
Brick, common	112	Limestone, rubble masonry	168
Brick, pressed	140	Marble	170
Cast Iron	450	Mortar	100
Portland Cement	88	Oak, dry	55
Charcoal, hardwood	20–35	Pine, dry, yellow	42
Charcoal, pine	18	Pine, dry white	30
Clay	119	Plaster	140
Coke, loose	30	Sand, wet	118–120
Concrete, stone	140–150	Sand, dry	90–105
Concrete, gravel	145–150	Sandstone	150
Concrete, cinder	90–105	Sandstone masonry, well-dressed	145
Earth, common, loam, dry, loose	76	Slate	175
Earth, moderately rammed	95	Steel	480
Earth, as soft, flowing mud	108	Stone Work, mortar rubble	155
Glass	170	Tallow	59
Granite	170	Water, pure	62.25
Granite, masonry, well-dressed	165	Water, sea	64



One of the latest and the largest buildings erected by The T. Eaton Co., Limited, at Toronto. This 14 story reinforced concrete building was designed by The T. Eaton Co's. engineers and erected by Messrs. Thomson Bros., General Contractors, and The Crescent Concrete Co., Limited, Concrete Contractors. "Steelcrete" Reinforcement and Fireproofing throughout. All stair wells, elevator shafts, etc., are fireproofed with "Fenestra" Solid Steel Partitions, Doors, etc.

CONCRETE MIXTURES

Concrete is composed of a matrix, which may be either a Portland or a natural cement mortar, and an aggregate of either slag, shells, broken bricks, cinders, gravel or broken stone. Widely varying proportions are used for mixing concrete in general practice, and in many cases the quantities are gauged in so crude a manner as to result in a waste of material and indifferent concrete.

The proportion of matrix should slightly exceed the voids in the aggregate, so that each particle of the latter may be entirely covered with mortar. It is, therefore, evident, that the proportion of voids in the aggregate, to be used in each particular case, should be ascertained in order to secure the best results. This is simply done by filling a vessel of known capacity level full, with the loose aggregate, having previously thoroughly wet the latter. Then pour in as much water as the vessel will contain, and divide the volume of the water poured in by the volume of the vessel, the quotient will represent the proportion of voids. The mixture may then be proportioned accordingly, which will not only produce a better grade of concrete, but frequently effect a material saving over the common method of arbitrarily adopting one of the usual proportions, regardless of the nature of the ingredients. In general, for both sand and stone, the particles should vary in size, within certain limits, so that the smaller sizes shall partly fill the voids of the larger, thus forming a stronger concrete with a less amount of cement. No hard and fast rules can be laid down for mixing concrete, either by hand or by machinery; the main object is to secure a thorough mixture of the ingredients at a reasonable cost. Machine mixing is undoubtedly superior, and is usually adopted whenever it is practical to do so; the mixing machine, however, does not relieve one of the responsibility of exercising the proper precautions dictated by experience and common sense, one of which is constant and competent supervision of the mixing.

There has been more or less controversy as to the superiority of wet or dry mixtures. The consensus of opinion of a majority of engineers favors a surplus rather than too small a quantity of water, and recent experiments and experience indicate quite clearly that wet mixtures offer better protection to imbedded materials and are consequently preferable for reinforced concrete.

Another distinct advantage of a wet mixture is that it may be placed at a less cost than a dry mixture.

Quantities of materials for one cubic yard of Rammed Concrete. Based on a barrel of 3.8 cubic feet.

(From Taylor & Thompson's "Concrete Plain and Reinforced." Copyrighted 1905, by Fred. W. Taylor.)

PROPORTIONS BY PARTS			PERCENTAGES OF VOIDS IN BROKEN STONE OR GRAVEL											
			50 Per Cent.*			**45 Per Cent.†**			40 Per Cent.‡			30 Per Cent.△		
Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone	Cement	Sand	Stone
			Bbl.	Cu. Yd.	Cu. Yd.	Bbl.	Cu. Yd.	Cu. Yd.	Bbl.	Cu. Yd.	Cu. Yd.	Bbl.	Cu. Yd.	Cu. Yd.
1	1	2	2.85	0.40	0.80	2.73	0.38	0.77	2.62	0.37	0.74	2.43	0.34	0.68
1	1	3	2.34	0.33	0.99	2.22	0.31	0.94	2.12	0.30	0.90	1.93	0.27	0.82
1	1½	3	2.09	0.44	0.88	2.00	0.42	0.84	1.91	0.40	0.81	1.76	0.37	0.74
1	1½	4	1.80	0.38	1.01	1.71	0.36	0.96	1.63	0.34	0.92	1.48	0.31	0.83
1	2	3	1.89	0.53	0.80	1.81	0.51	0.76	1.74	0.49	0.74	1.61	0.45	0.68
1	2	3½	1.76	0.49	0.87	1.68	0.47	0.83	1.61	0.45	0.79	1.48	0.42	0.73
1	2	4	1.65	0.46	0.93	1.57	0.44	0.88	1.50	0.42	0.84	1.38	0.39	0.78
1	2	4½	1.55	0.44	0.98	1.48	0.42	0.94	1.41	0.40	0.89	1.28	0.36	0.81
1	2	5	1.47	0.41	1.03	1.39	0.39	0.98	1.32	0.37	0.93	1.20	0.34	0.84
1	2½	3	1.72	0.61	0.73	1.66	0.58	0.70	1.60	0.56	0.68	1.49	0.52	0.63
1	2½	3½	1.62	0.57	0.80	1.55	0.55	0.76	1.49	0.52	0.73	1.38	0.49	0.68
1	2½	4	1.52	0.54	0.86	1.46	0.51	0.82	1.40	0.49	0.79	1.29	0.45	0.73
1	2½	4½	1.44	0.51	0.91	1.37	0.48	0.87	1.31	0.46	0.83	1.20	0.42	0.76
1	2½	5	1.37	0.48	0.96	1.30	0.46	0.92	1.24	0.44	0.87	1.13	0.40	0.80
1	2½	5½	1.30	0.46	1.01	1.23	0.43	0.95	1.17	0.41	0.91	1.07	0.38	0.83
1	2½	6	1.24	0.44	1.05	1.17	0.41	0.99	1.11	0.39	0.94	1.01	0.36	0.85
1	3	5	1.28	0.54	0.90	1.22	0.52	0.86	1.17	0.49	0.82	1.07	0.45	0.75
1	3	6	1.16	0.49	0.98	1.11	0.47	0.94	1.05	0.44	0.89	0.96	0.41	0.81
1	3	7	1.07	0.45	1.05	1.01	0.43	0.99	0.96	0.40	0.95	0.87	0.37	0.86
1	4	6	1.04	0.59	0.88	0.99	0.56	0.84	0.95	0.54	0.80	0.87	0.49	0.73
1	4	7	0.96	0.54	0.95	0.92	0.52	0.91	0.88	0.50	0.87	0.80	0.45	0.79
1	4	8	0.90	0.51	1.01	0.85	0.48	0.96	0.81	0.46	0.91	0.74	0.42	0.83

NOTE.—Variations in the fineness of the sand and the compacting of the concrete may affect the quantities by 10 per cent. in either direction.

*Use 50 per cent. columns for broken stone screened to uniform size.

†Use 45 per cent. columns for average conditions and for broken stone with dust screened out.

‡Use 40 per cent. columns for gravel or mixed stone and gravel.

△Use 30 per cent. columns for scientifically graded mixture.

1 bbl. cement and 2 bbl. sand will cover 99 sq. ft. of floor 1 in. thick.
1 bbl. cement and 1 bbl. sand will cover 68 sq. ft. of floor 1 in. thick.

Southam Press (Mail Job Printing Co.) Building, Toronto

Messrs. Sproatt & Rolph, Architects, Toronto

A simply designed, well proportioned reinforced concrete structure curtain wall with bricks.

Data taken from Bulletin No. 5, May, 1909.
Canadian Society Civil Engineers.

Comparative costs of construction, based on bona-fide tenders for different systems:

(a) Steel beams and columns, concrete floors and roof, and fireproofing of steel, ... Lowest tender $50,500

(b) Steel beams and columns, tile floors and roof, and fireproofing of steel . . . . Lowest tender. 46,500

(c) Reinforced concrete and columns, beams, floors and roof,
Lowest tender. 37,825
Highest tender 48,000

"In systems (a) and (b), the tenders did not vary to any great extent. "In system (c), the majority of tenders were close around $40,000. Amongst "the systems put forward by those tendering, were the Kahn, Hennebique, "Expanded Metal and various forms of plain bar reinforcement."

This victory for reinforced concrete construction over other fireproofing types, was won by the Expanded Metal and Fireproofing Co., Limited, of Toronto, the tender upon their system being lowest. The writer of the paper in the Bulletin referred to, Mr. W. N. Moorehouse, (Sproatt & Rolph) states as follows, regarding the speed of reinforced concrete construction:—"To give a general idea, it might be remarked "that in the building erected in Toronto, for the Ault & Wiborg Co., on "Charlotte Street, the average rate of placing each floor of **5,400 sq. ft.** "area was ten days. This building was of the type known as 'Mill Con-"struction' with 2¾ inch spliced plank floors and Georgia pine beams,

"and was completed within a close time limit. In the Mail Job Printing "Company's building, herein described, the time taken to lay each floor "of 10,000 sq. ft. area, including setting up of forms, placing of reinforcement "and such ducts, leads, etc., as were fixtures in the slab, and pouring of "columns, beams and slab, was two weeks.

"In conclusion" (a final quotation) "the writer wishes to state that "he has set these facts and figures down from his own experience, with "a mind quite unprejudiced in favor of any particular type of construction."

The reader is referred to Mr. Moorehouse's paper, which is replete with interesting information regarding the progress and itemized cost of an actual reinforced concrete building.

Lessons from the foregoing:

(a) Reinforced Concrete Buildings can be erected quicker than Mill Construction.

(b) Reinforced concrete floors are over 15% cheaper than Tile floors, for any given loadings, even in Toronto, where Reinforced Concrete by-laws are unusually rigid.

(c) Concrete Floors with Expanded Metal are cheaper than those with **other types of reinforcement.**

Interior, Southam Press Building

Messrs. Thomas Ogilvie & Son's Fireproof Building, Toronto.]
Messrs. Burke, Horwood & White, Architects
A Reinforced Concrete Structure ("Steelcrete" System) with brick walls

Bank of Nova Scotia Bldg., Winnipeg, Messrs. Darling and Pearson, Architects.
"Steelecrete" Reinforcement and Lath.

A REMARKABLE TEST

The accompanying letter from Mr. Peter Gillespie, Lecturer in Applied Mechanics, University of Toronto, refers to the test illustrated and described herewith.

The slab was a 4 inch cinder concrete 1:2:6 mixture. The span was 9 ft. 9 inches. The Slab reinforced with our Plate No. 31025 "Steelcrete Expanded Metal" was designed for a live load of 100 lbs. per sq. ft. The "Steelcrete" Expanded Metal was cut and lapped one mesh or 8 inches in the centre of the slab, to again prove that Expanded Metal lapped one mesh will develop the full strength of the steel. When the slab finally broke at something over 800 lbs. per sq. ft. the metal was found to have parted at a point 1 inch clear of the lap, thus proving again that a continuous reinforcement second to none is procured by use of "Steelecrete" Expanded Metal.

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE AND ENGINEERING

TORONTO. CANADA

January 12th, 1910.

Messrs. Expanded Metal & Fireproofing Co. Limited,

Fraser Ave., Toronto.

Gentlemen -

On Dec. 10th and 11th, 1909, I witnessed at your factory, Fraser Avenue, Toronto, a test to destruction conducted on a reinforced cinder concrete slab. The general features and dimensions of the test panel are indicated on the accompanying blue print. There are, however, these exceptions - the wooden floor and the 18" girders along the sides were not in place; and since there was but one panel, there was no continuity over supports. With these 18" girders in place the loads as given below would undoubtedly be very much greater, the fact that the test panel was isolated being an additional reason also.

Prior to loading, a layer of 2" planks was laid with their lengths transverse to the slab upon these, the sacks of cement and gravel constituting the load, were placed. The deflection was measured by means of a scale attached to a post which was supported on the centre of the slab. The simultaneous values of centre deflection and load in pds. per sq. foot, are given in the table below. Failure occurred by a transverse rupture of both metal and concrete at a load slightly in excess of 800 per sq. ft.

Load	Deflection	Load	Deflection.
60 lbs. per sq. ft.	1/16"	420 lbs. per sq. ft.	9/16"
120	1/8"	480	3/4"
180	3/16"	540	1"
240	1/4"	600	1 1/8"
300	5/16"	800	2"
360	1/2"	800	Failure

The test was begun on the afternoon of Dec. 10th, and concluded on the morning of the 11th. The load remaining on over night was 600 pds per sq. ft., with no noticeable increase in deflection.

Very truly yours.

Peter Gillespie

Lecturer in Applied Mechanics.

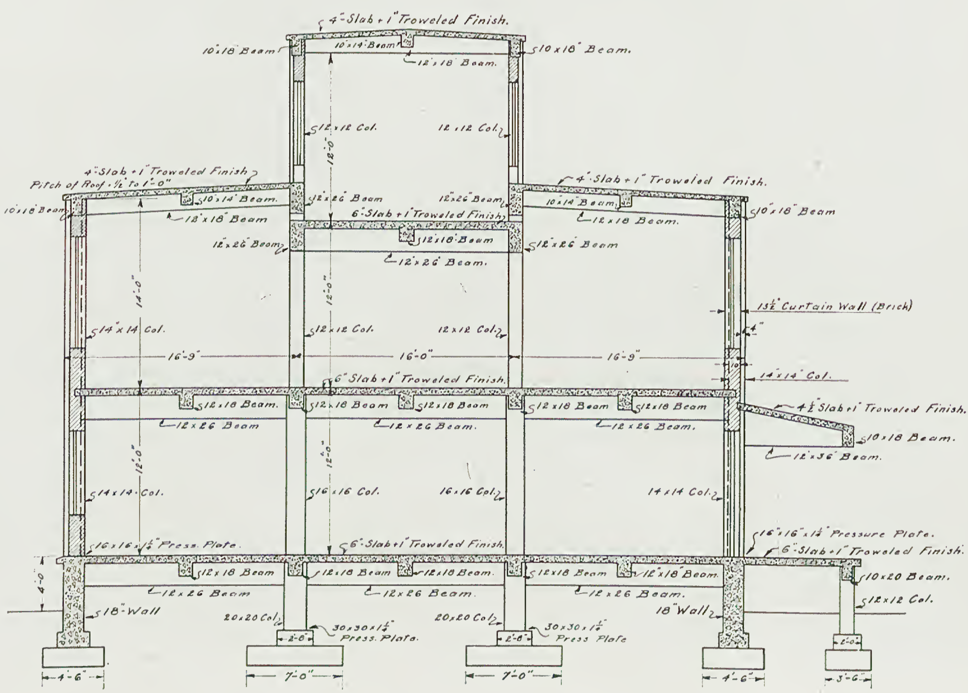
The new Head Office Building of The Standard Bank at Toronto
Messrs. Darling & Pearson, Architects. Messrs. Fussel & Thomas, General Contractors.
Messrs. Leach Concrete Co., Reinforced Concrete Contractors. "Steelcrete" Reinforcement

Canada Permanent Office Building, Winnipeg. Mr. J. D. Atchison, Architect.
"Steelcrete" Expanded Metal Reinforcement and Lath used throughout.

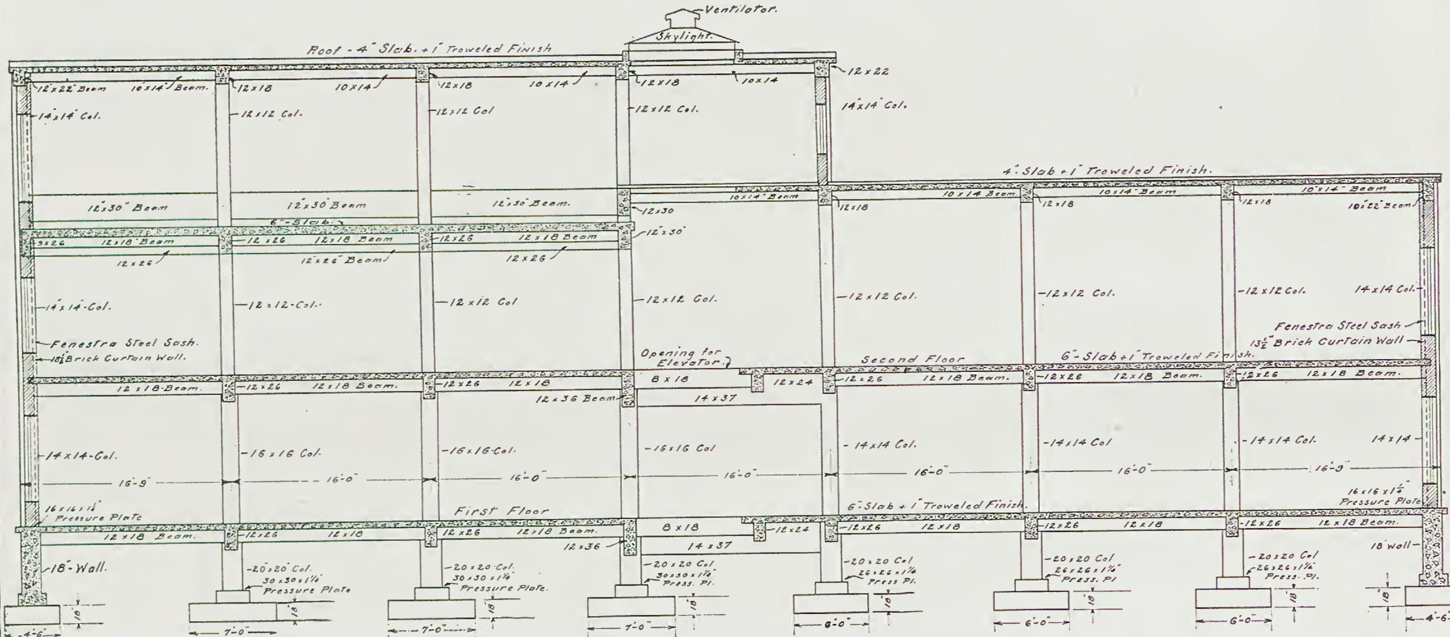
TYPICAL REINFORCED CONCRETE CONSTRUCTION

The longitudinal and transverse sections of a typical all-reinforced concrete building are shown herewith, and give a good idea of the methods pursued in the construction of a monolithic concrete building. It is reinforced concrete from footing to roof. The entire structure is connected rigidly, thus minimizing vibration. Buildings of this type best withstood the effects of the San Francisco Earthquake, and for reasons easily understood by engineers or architects.

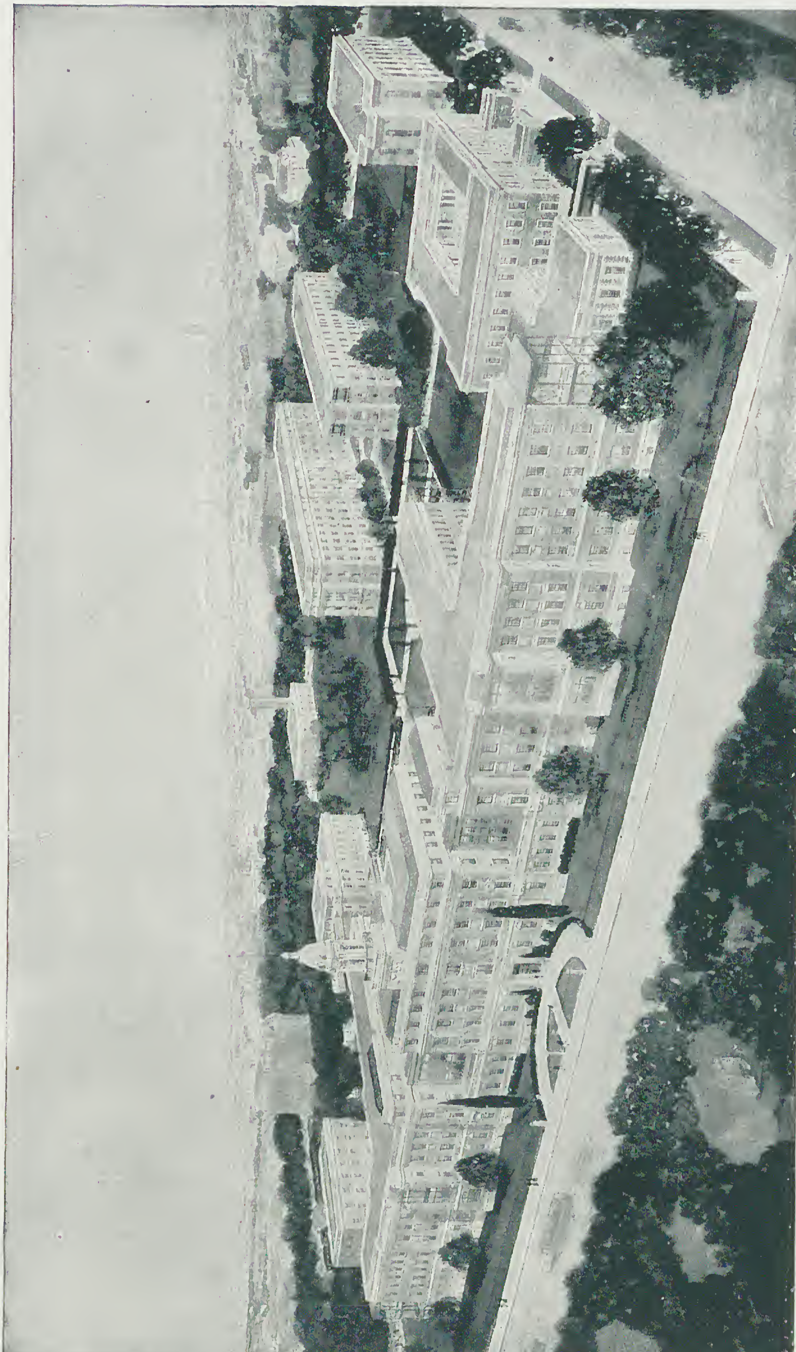
We supply the reinforcement for these buildings entire, with columns and beam rods fabricated and ready to drop into the concrete forms. With shipment are supplied working drawings with all beams numbered, and all rods in each beam numbered so that the foreman finds the placing of his reinforcement the simplest phase of his work.



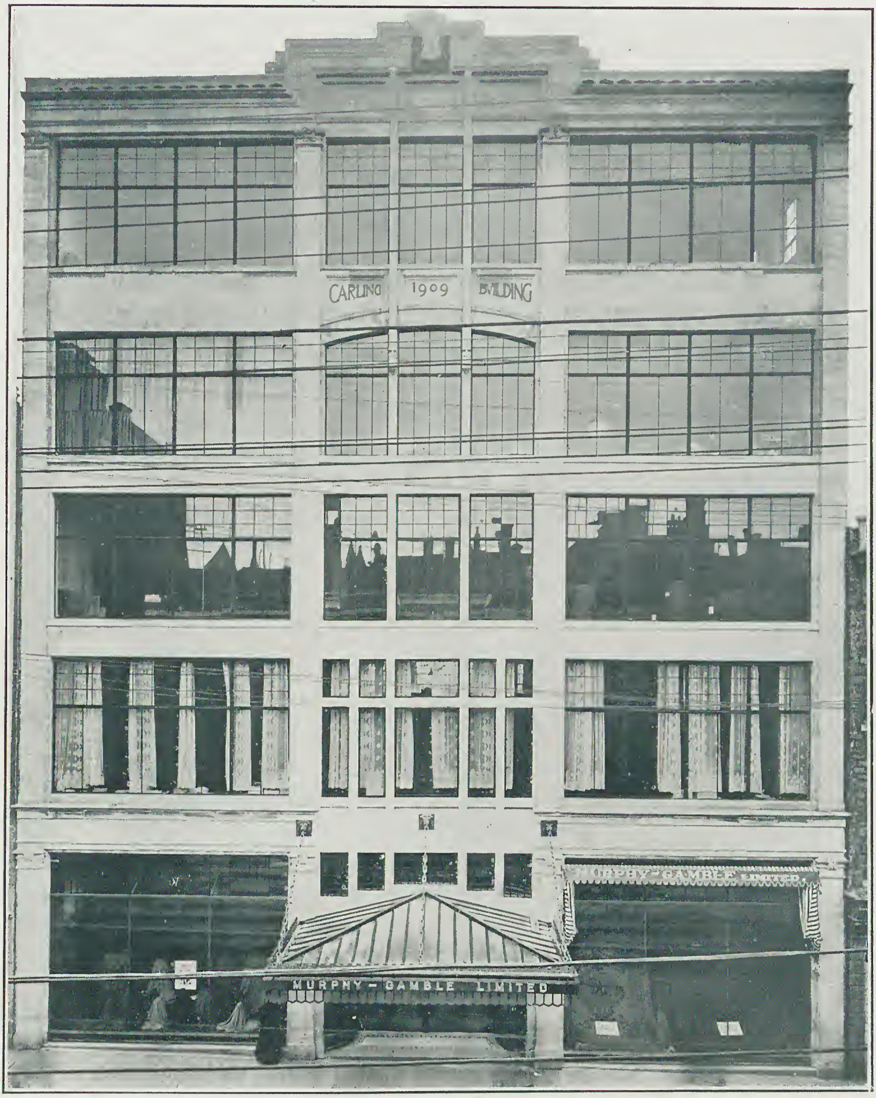
CONSTRUCTION OF A MONOLITHIC CONCRETE BUILDING



Longitudinal and Transverse (opposite page) sections of The Cudahy Packing Co. (Old Dutch Cleanser Plant, Toronto). Reinforced throughout with "Steelcrete" Products.

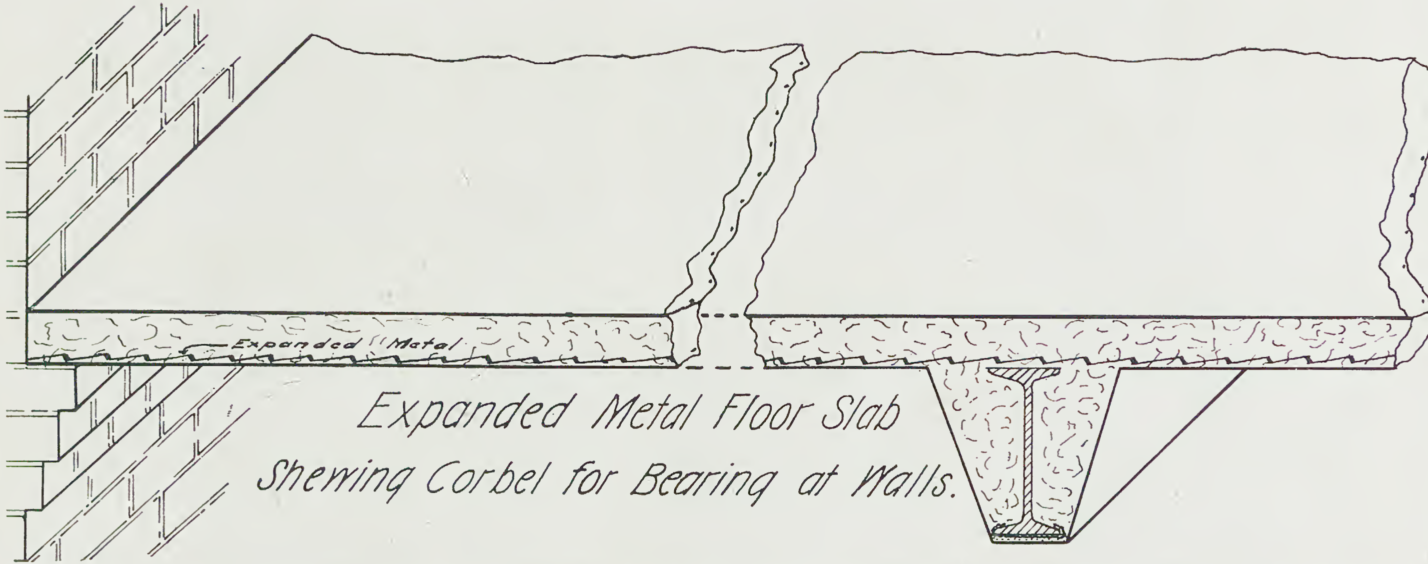


A Bird's Eye View of the Magnificent Group of Buildings designed by Messrs. Darling & Pearson for the new Toronto General Hospital. An enormous quantity of Steelcrete Products will be used throughout these Buildings.



The Carling Building, Ottawa

A Reinforced Concrete Building. "Steelcrete" Products, also "Fenestra" high-grade Steel Casements installed on both Sparks & Queen Street Elevations
C. P. Meredith, Architect Alex. Garvock, Contractor



Expanded Metal Floor Slab
Shewing Corbel for Bearing at Walls.

Proposals will be received from contractors for the reinforced concrete construction where shown on plans or mentioned in specifications.

The contractor will be required to submit with his proposal, a full description and sufficient detail drawings to elucidate same perfectly, showing the methods to be employed in construction, together with a guarantee from the company supplying the reinforcing steel, that the specified safe live floor loads, with the proper safety factor, have been adhered to, and that the design throughout conforms to best standard reinforced concrete practice.

The contractor is to keep on the works constantly a competent foreman to superintend the reinforced concrete construction. Contractor shall furnish all material and labor necessary for its proper execution.

The whole of the work to be performed in a substantial, workmanlike and perfect manner, according to the true intent of the plans and specifications.

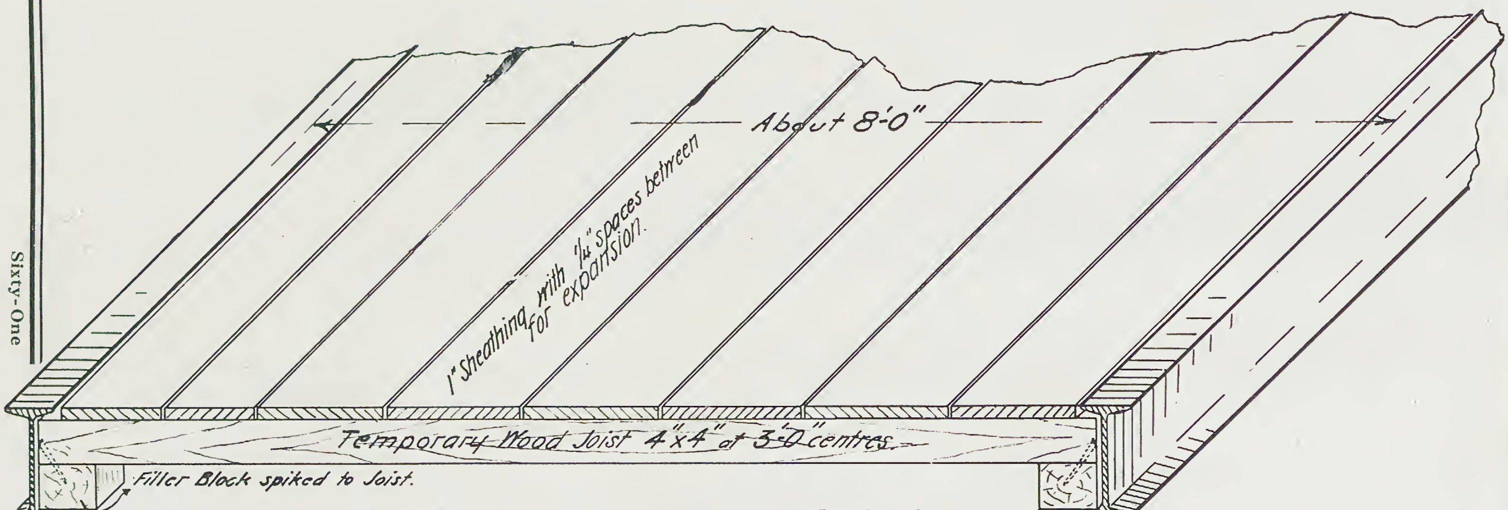
No defective or unsound materials shall be used in the building or brought on the premises, but all materials shall be of the best quality of their respective kinds.

Cement—Portland Cement used shall be of a standard brand to be approved by the architect, and after being sampled and tested to his satisfaction, shall be suitably stored.

Sand—Sand to be clean, hard and durable in grain, and to be of graded sizes with the coarse particles predominating. Not over 5% of clay will be permitted and loam must be entirely absent.

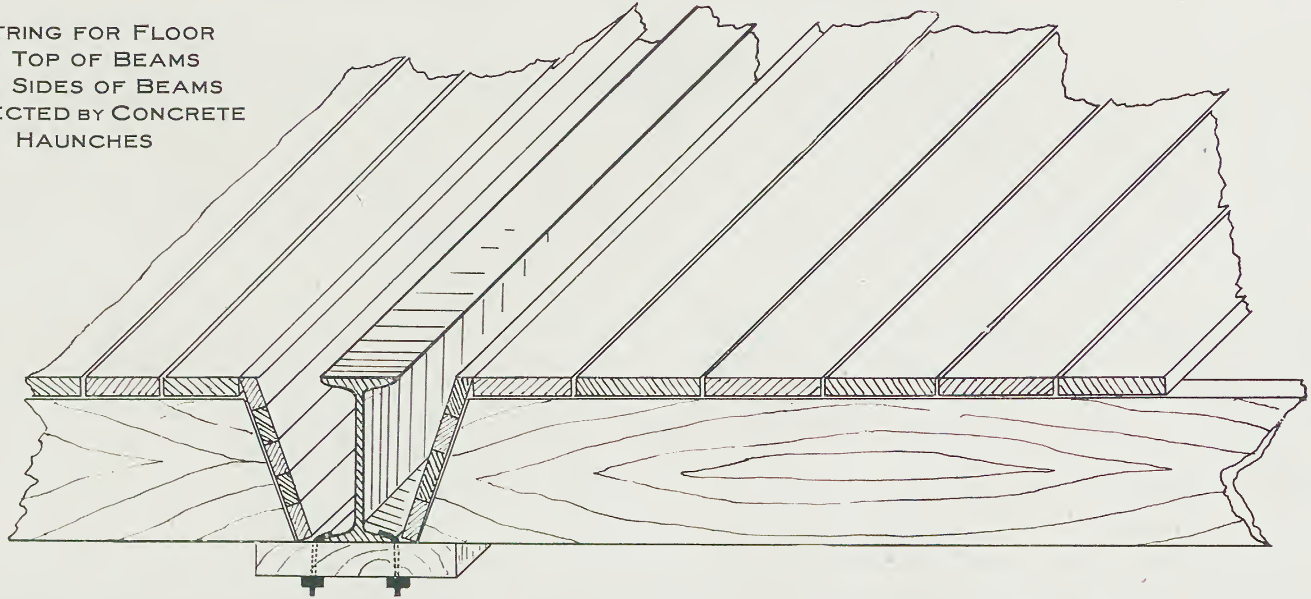
Stone—Stone to be hard, durable limestone or other stone of equal toughness, and broken to pass through a ¾ inch ring. If gravel is used instead of stone, it shall be clean and graded in size. If by screening, it is

(*Continued*)



Centring for Floor-bearing on top of steel beams.

CENTRING FOR FLOOR
ON TOP OF BEAMS
WITH SIDES OF BEAMS
PROTECTED BY CONCRETE
HAUNCHES



determined that the component sand and stone does not give the specified proportions of rough aggregate, sand shall be added or removed to give the required proportion.

Forms—Wood forms shall be erected in true substantial manner to give finished dimensions of concrete, as shown on plans. Forms to be thoroughly strutted and braced to prevent deflection. Forms to be such that finished work shall be free from checks, cracks, pocket holes, etc. All to be well wet down before placing of concrete, after being swept clean and free from shavings. Beam forms should be sprung to give a cambre ¼ inch per 10 ft. Care must be taken to prevent any shavings, cuttings or foreign material remaining in bottom of column boxes, and in order to do this, door of sufficient size should be made in bottom of box to allow for cleaning.

SPECIFICATION FOR REINFORCED CONCRETE—*Continued*

Mixture—All concrete for reinforced construction to be thoroughly mixed in rotary mixer, in proportions—4 stone, 2 sand, 1 Portland cement. If the nature of aggregate proves to the architect that these proportions should be altered to secure a concrete of desired density, the contractor is to proceed as directed. Consistency to be what is known as "Wet Mix", to necessitate no tamping, but allowing free flowing of the concrete and perfect surrounding of the steel rods and Expanded Metal.

Placing—If wheeling of the concrete be of character to allow a settlement of the coarse aggregate, each barrowful shall be emptied on the floor forms, when filling beam boxes or column boxes, and thence, after turning, if necessary, shovelled into place. All concrete shall be thoroughly spaded or puddled to insure against separation of the particles. All steel must occupy the exact relative position shown on detail plans. Where the work is stopped temporarily, the joint must be made in such manner that it will not affect the compressive or shearing strength of the beam or plate. The concrete must be kept moist for several days after being deposited, particularly in hot weather. Columns are to be filled in one operation to level of bottom of the girder forms.

Removal of Forms—Centring shall not be moved until concrete is thoroughly set, nor until architect's permission is obtained. Column and wall forms can be removed sooner than slabs or beam forms, within two to four days; but they should not be subject to weight under twenty or thirty days. Forms should not be removed from slabs under from four to fourteen days, and they should not be subjected to load under twenty to thirty days. The load should not exceed 75% at twenty days, nor 80% at thirty days, of the load for which the structure is designed.

Reinforcement—(To suit different conditions, the following alternative specifications for Expanded Metal are given, from which choice can be made.)

The reinforcement shall be Plate No. — "Steelcrete" Expanded Metal. —or

The reinforcement shall be "Steelcrete" Expanded Metal adequate for a superimposed live load of — lbs. per sq. ft., with slab thickness as shown on plans. Safety factor 4 on total load.—or

The slabs shall be — inches thick, composed of concrete mixed in proportions as described above, and shall be reinforced with Steelcrete Expanded Metal to carry a superimposed live load of — lbs. per sq. ft. Safety Factor 4 on total load.

Sufficient of the steel rod reinforcement for beams shall be trussed or bent up towards the supports to take up shear stresses, and plans to be submitted indicating such trussing in detail.

Tests—At the discretion of the Architect, the contractor is required to test any portion of his work, thirty days after the removal of forms, to a uniformly distributed load equal to twice the safe live load specified, and there shall be no permanent set.

Spacing and Size of Joist in Floor Centering

		Slab thickness	3½"	4"	4½"	5"	5½"	6"	6½"	7"	7½"	8"	8½"	9"
7/8" Flooring	2" x 6" Clear Span in feet	5'	33"	31	29	27	25	24	23	22	21	20	19	18
		6'	23"	21	20	19	18							
		7'												
	2" x 8" Clear Span in feet		1¾" Flooring →											
		6'	42	37	35	33	30	30	28	27	26	24	23	22
		7'	30"	28	26	25	23	22	21	20	18			
		8'	23"	21	20	19	18							
		9'	18"											
	2" x 10" Clear Span in feet		← 1¾" Flooring →											
		8'	35"	33	32	30	28	26	25	24	22	21	21	20
		9'	28"	26	25	23	22	21	19	18				
		10'	23"	21	20	19	18							
		11'	19"											

Safe Clear Spans for 7/8" and 1¾" Boards.

7/8" Stock	35"	34	33	32	31	30	29	28	28	27	27	26
1¾"	70	68	65	64	62	60	59	57	55	54	52	52

WATERPROOFING CONCRETE

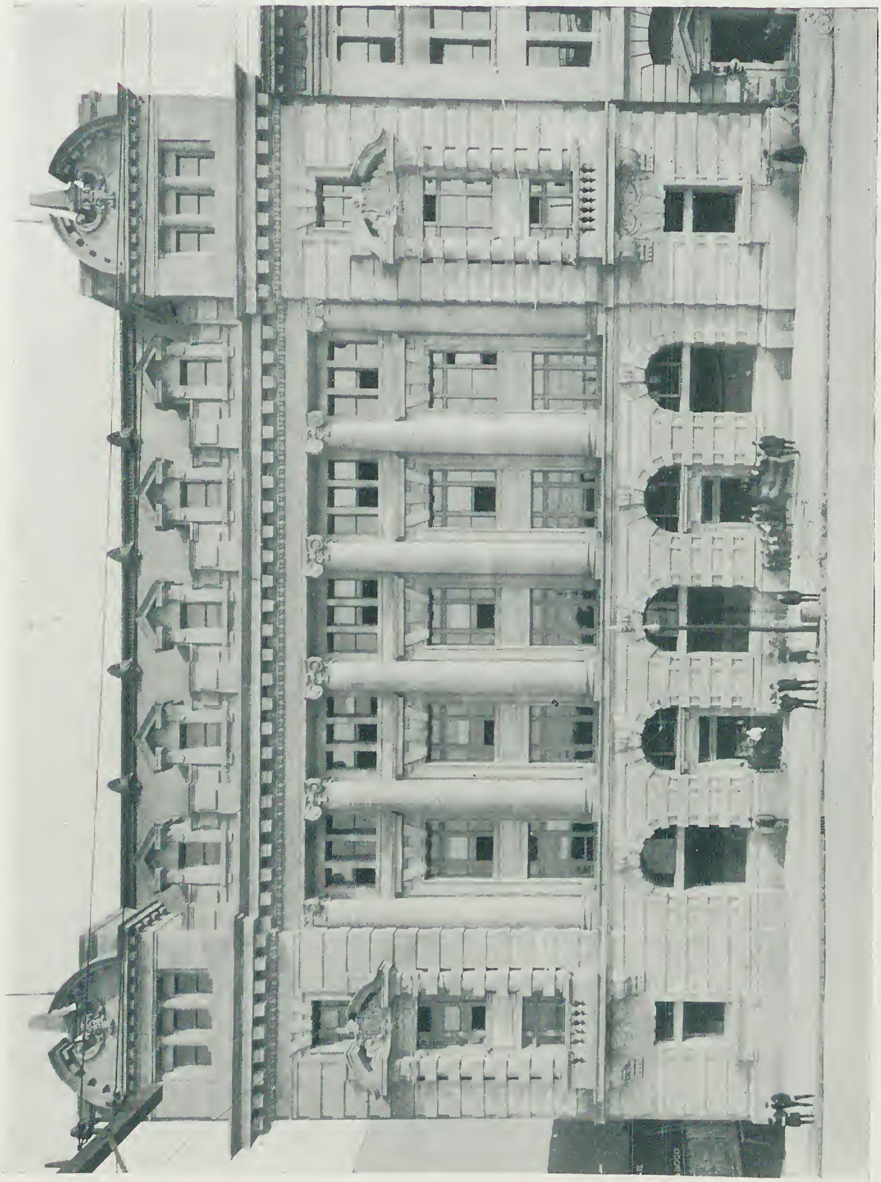
The question of how to waterproof concrete is often a very important one. The "Sylvester Process" has been used on fortification works, and others where it has been subject to twenty feet or more head of water, with success. The material should be mixed and applied as follows: Thoroughly dissolve ¾ lb. of shaved Castile soap in 1 gallon of water, also dissolve ½ lb. of powdered alum in 4 gallons of water. The walls should be dry and the soap wash applied first, at a boiling heat, being laid on with a flat brush and not allowed to froth. After the soap wash has been on about twenty-four hours and is thoroughly dry, the alum wash is applied in the same manner, being at a temperature of about 65°. This also should be allowed to dry for twenty-four hours before a second coat is put on. In a few cases, one coat each of the two mixtures have been sufficient; generally two or three coats of each are necessary to make the concrete impervious to water. The application of the process gives the concrete a uniform color and generally improves the appearance.

CONCRETE SURFACES

The appearance of concrete surfaces may be varied greatly, depending upon the skill and intellignece of the workman and upon the forms used. For ordinary vertical surfaces, use planed, tongued and grooved boards in which there are no holes for the mortar to escape. As the concrete is deposited, an ordinary garden fork or spade with holes, is thrust down he inside facing of forms, so as to work the stone back, leaving the sand and cement against the boards. By this method a smooth, hard and uniform surface is obtained at a nominal cost.

By removing the forms while the concrete is "green", the surface may be treated in various ways. For instance, the surface may be stuccoed or the aggregates may be exposed by the use of a hose or scrubbing brush, in which case the general effect would depend upon the aggregates used. Very perfect surfaces are obtained by rubbing the concrete smooth with a carborundum brick.

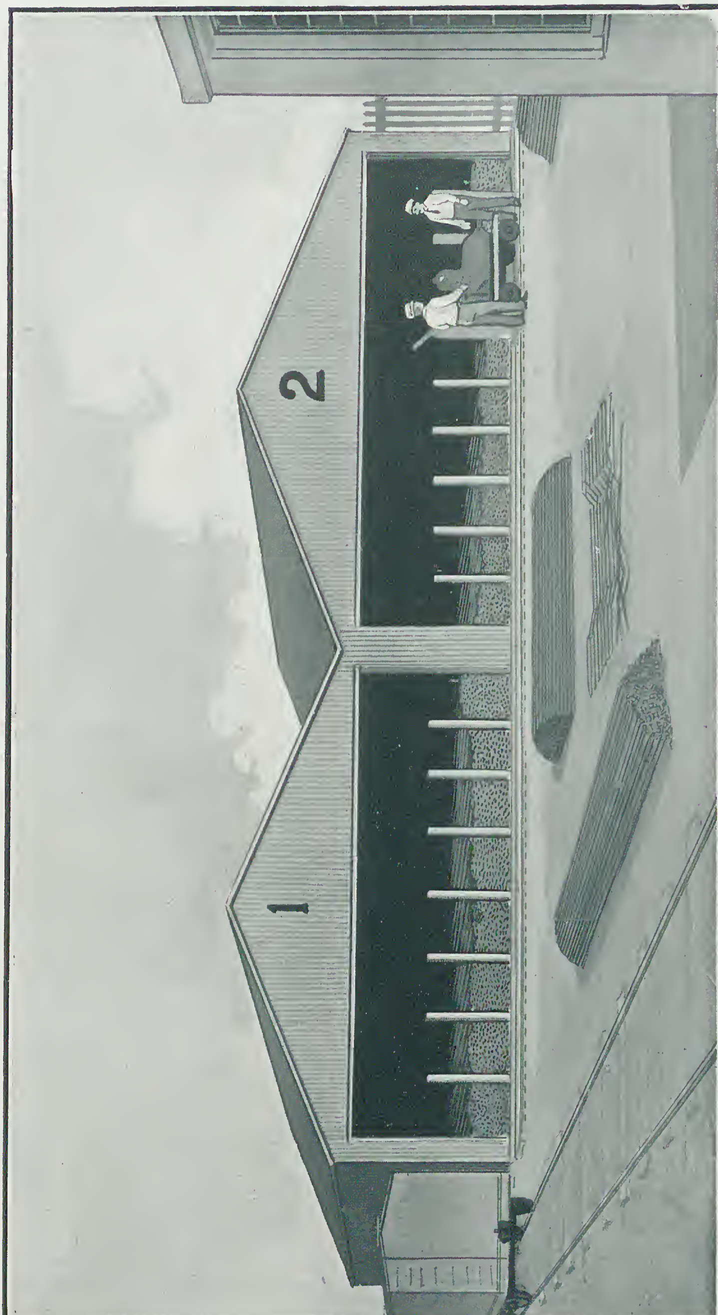
Wherever it is practical to remove the forms while the concrete is "green", the general effect is under the control of the designer.



New General Post Office, Winnipeg, Man. Messrs. Darling & Pearson, Architects

This fine Building, as well as nearly all the rest of the new Government Buildings throughout the West, is Steelcrete so far as Reinforcement, Fireproofing and Interior Plaster Finish are concerned.

Mr. J. C. Eaton's new Residence is here shown in a somewhat unfinished condition. This is one of our finest Canadian homes. It was designed by Messrs. Wickson & Gregg, Architects, and built by Messrs. Thomson Bros. It is an absolutely fireproof building. "Steelcrete" Reinforcement and Hot Dip Galvanized Lath throughout



ROD AND BAR SHEDS Nos. 1 AND 2, AT OUR WORKS, FRASER AVE., TORONTO

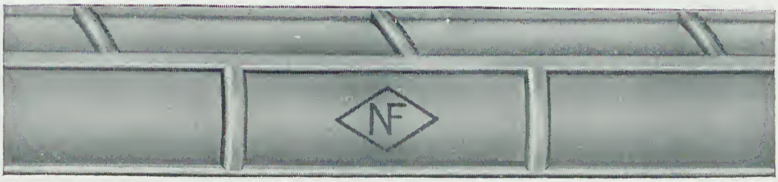
Where we have exceptional facilities for quick handling, fabricating and shipping.

RODS AND BARS FOR REINFORCEMENT

Where our customers' delivery dates allow, we fill orders for Plain Round or Square, Square Twisted or "Klutch" Bars direct from the Mill cut to required lengths and if desired, bent to required shapes ready for placing in girders, beams, floors, etc.

But for the convenience of our friends, the Architects, Engineers and Contractors, we carry in our rod sheds for quick shipment a large stock of all sizes of Plain and "Klutch" Barsin lengths up to 64 ft. Our unsurpassed facilities for handling, storing and fabricating rods make this stock a much appreciated and much patronized convenience. Of course material thus carried and handled cannot be sold at mill prices, nor does any reasonable man expect it. When some steel is needed **quick,** price is not the greatest consideration. Send us your lists for quotations, either on mill deliveries or deliveries from stock. Both will be good.

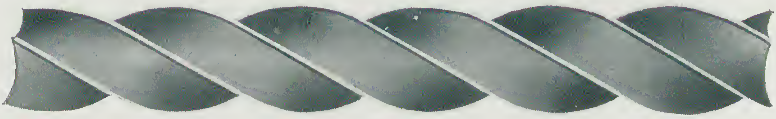
RODS AND BARS FOR REINFORCEMENT



"Klutch" Bar

Plain Round Rod

Plain Square Bar



Square Twisted Bar

"KLUTCH" BARS

In our "Klutch" deformed bar, we present a model which is based on all previous known forms, with a careful study of their defects and excellencies estimated from their own and collateral records.

The usual advantages claimed for deformed bar, which, as a general classification, is now the only admitted type, are that the metal is **all** disposable for tensile strength, that it forms a certain mechanical bond and is absolutely independent of mere surface adhesion.

Further, that it will prevent all local "Slipping" and consequent fissures, and finally that it has the highest elastic limit—between 50,000 and 65,000 pounds per square inch, as against 33,000 pounds in ordinary commercial steel.

In addition to all of the above advantages, we claim for our "Klutch" reinforcing bar that the longitudinal ribs on the four corners of our bar add to the tensile strength and prevent tortional strains in the concrete.

In the "Klutch" reinforcing bar, the cross ribs form a mechanical bond and less metal is required to make a proven bond under this than any other bar system.

Over **all other** forms of reinforcing bars, we claim this for the "Klutch" Reinforcing Bar.

1. Greater tensional strength and consequent prevention of strain and less liability to fissure.

2. That less metal is required to make a proven bond.

Reducing the whole problem to its simplest and most effective terms, the only other desideratum in the employment of a reinforcing bond is **quality of material.** This is a not less important point than the others we have claimed and cannot be too strongly insisted upon when making up specifications. As a matter of fact, it is the least looked after of any.

Too much is it still regarded in construction work, particularly of the lighter kinds, that almost "any old thing" will do. Ordinary mill steel, much of it off-heats, is still employed in too great a percentage of production. "Klutch" Reinforcing Bar is of the very highest constructive quality.

The "Klutch" Mill makes the steel as well as the bar, and is the only concern in Canada which makes both the steel and the bar.

"Klutch" Bar is all made from bottom cast Open Hearth steel. Although Bessemer is still used, Open Hearth has long had the preference of the highest authorities.

Each heat is tested by chemical analysis to insure the proper chemical composition of the metal. After rolling, the steel is submitted to the most careful tensile tests. If it does not come up to required standards, it is rejected for "Klutch" Reinforcing Bar, and utilized for other purposes.

University of Toronto, Library Building. Messrs. Darling & Pearson, Architects

This fine structure and its sister building, The Museum Building, now under construction, are both "Steelcrete" Buildings. The large windows shown in the Stack Room are "Fenestra" solid steel fireproof construction.

Table Showing Cross Sectional Area in Square Inches, and Weight per Square Foot of Plain Round or Square, Square Twisted and "Klutch Bars".

One Cubic Foot weighing 489.6 lbs.

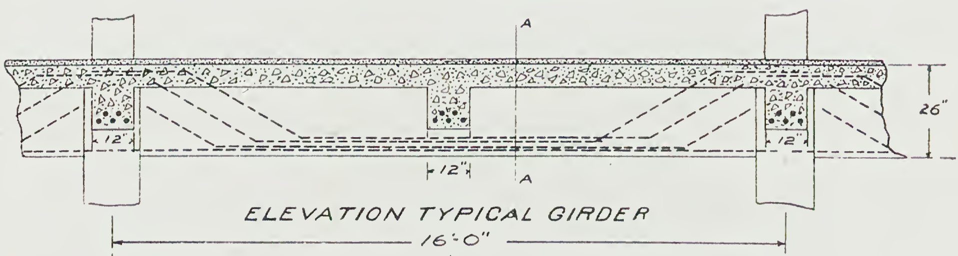
Size of Bar	"KLUTCH" BAR		PLAIN ROUND		PLAIN SQUARE		SQUARE TWISTED	
	Sectional Area	Weight per foot	Area	Weight	Area	Weight	Area	Weight
¼	.062	.212	.049	.167	.062	.212	.062	.212
⅜	.140	.478	.110	.376	.140	.478	.140	.478
½	.250	.850	.196	.668	.250	.850	.250	.850
⅝	.390	1.328	.306	1.043	.390	1.328	.390	1.328
¾	.562	1.913	.441	1.502	.562	1.913	.562	1.913
⅞	.765	2.603	.601	2.044	.765	2.603	.765	2.603
1	1.000	3.400	.785	2.670	1.000	3.400	1.000	3.400
1⅛	1.265	4.303	.994	3.380	1.265	4.303	1.265	4.303
1¼	1.562	5.313	1.227	4.172	1.562	5.313	1.562	5.313
1⅜	1.890	6.428	1.484	5.049	1.890	6.428	1.890	6.428
1½	2.250	7.650	1.767	6.008	2.250	7.650	2.250	7.650
1⅝	2.640	8.978	2.073	7.051	2.640	8.978	2.640	8.978
1¾	3.062	10.41	2.405	8.178	3.062	10.41	3.062	10.41
1¾	3.515	11.95	2.761	9.388	3.515	11.95	3.515	11.95

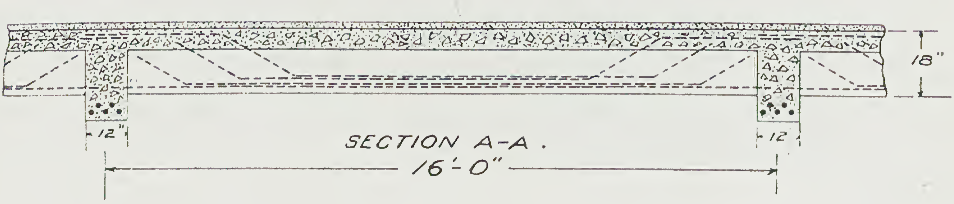
RODS FOR BEAMS AND GIRDERS

There are three devices adopted to reinforce against diagonal and shearing stresses in beam work. Firstly, bending up from the proper points, sufficient of the main horizontal rods towards the supports; Secondly, using stirrups carried under the main rods and extending vertically or sloped to the top of the beam, or Thirdly, by bending up fins slit from the main rod. In ordinary building practice, except in extreme cases, ample provision can be made by the first mentioned method. These slanting portions of the rod act as truss diagonals, and have a tensional function. In rare cases, both stirrups and "trussing" are resorted to.

We have admirable facilities for shearing our rods to lengths as required, also for fabricating such material, whether in plain rods or "Klutch" Bars. Each rod is numbered, and with the shipment goes a key plan, indicating precisely where every rod goes and how. The problem of the reinforcement placement is thus rendered as simple as Kindergarten Work.

Quick delivery is the Keynote to our gratifying success in filling the exact specifications of engineers and architects from one coast of Canada to the other.

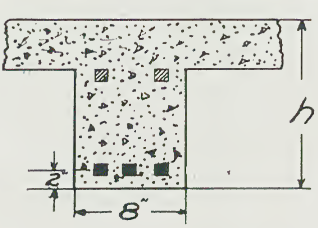




TYPICAL STEEL AND REINFORCED CONCRETE GIRDERS, BEAMS AND FLOORS

TOTAL SAFE LOADS
IN POUNDS
UNIFORMLY DISTRIBUTED
FOR
REINFORCED CONCRETE BEAMS
3-3/4" – "KLUTCH" BARS
AREA = 1.68 □"

Span in Feet	Depth in Inches = h					
	8	10	12	14	16	18
6	15500	20700				
7	13300	17700	22200			
8	11600	15500	19400			
9	10300	13800	17200	20700		
10	9300	12400	15500	18600	21700	
11		11300	14100	16900	19700	22600
12		10300	12900	15500	18100	20600
13			11900	14300	16700	19100
14			11100	13300	15500	17700
15			10300	12400	14400	16500
16				11600	13500	15500
17				10900	12700	14600
18					12000	13800
19					11400	13000
20					10800	12400
21						11800
22						11300
23						10800



h = Total depth of Beam in inches

$B.M = \frac{wl}{8}$

N.B. If beams are continuous over several supports, above loads may be increased 25%

TOTAL SAFE LOADS
IN POUNDS
UNIFORMLY DISTRIBUTED
FOR
REINFORCED CONCRETE BEAMS
3-1"—"KLUTCH" BARS.
AREA = 3·□"

SPAN IN FEET	Depth in Inches = h. 12	14	16	18	20	22	24	26	28	30
10	27500	33000	38500							
11	25000	30000	35000							
12	22900	27500	32100	36600						
13	21180	25400	28600	33800	38100					
14	19650	23600	27500	31400	35400	39300				
15	18300	22000	25600	29300	33000	36700	40300			
16		20600	24100	27500	31000	34400	37800	41200	44600	
17		19400	22600	25900	29100	32300	35600	38800	42000	45300
18			21400	24400	27500	30600	33600	36700	39700	42700
19			20200	23200	26100	29000	31800	34700	37600	40500
20			19200	22000	24800	27500	30200	33000	35700	38500
21				21000	23600	26200	28800	31400	34000	36700
22				20000	22500	25000	27500	30000	32500	35000
23					21500	23900	26300	28700	31100	33500
24					20600	22900	25200	27500	29800	32100
25					19800	22000	24200	26400	28600	30800
26						21200	23200	25400	27500	29600
27						20400	22400	24400	26500	28500
28							21600	23600	25500	27500
29							20800	22800	24600	26600
30							20200	22000	23800	25600
31								21300	23000	24800
32								20600	22300	24000
33									21700	23300
34									21000	22600
35									20400	22000
36										21400
37										20800
38										

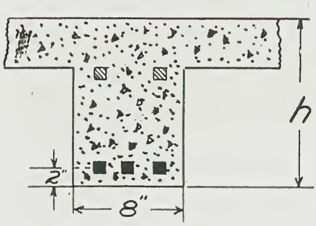
h = Total depth of Beam in inches

$$B.M. = \frac{Wl}{8}$$

N.B.—If beams are continuous over several supports, above loads may be increased 25%

TOTAL SAFE LOADS
IN POUNDS
UNIFORMLY DISTRIBUTED
FOR
REINFORCED CONCRETE BEAMS
3-1⅛" - "KLUTCH" BARS.
AREA = 3.78□"

Span in Feet	Depth in Inches = h									
	16	18	20	22	24	26	28	30	32	34
15	32400	37000	41500	46200	50800					
16	30400	34700	39000	43300	47700	52000				
17	28600	32600	36700	41800	44800	49000	53000			
18	27000	30800	34600	38600	42500	46200	50000	54000		
19	25600	29200	32800	36500	40200	43700	47500	51100	54800	
20	24300	27800	31200	34700	38200	41600	45000	48500	52000	55500
21		26400	29700	33000	36400	39600	43000	46200	49500	52800
22		25200	28400	31500	34700	37800	41000	44100	47300	50500
23		24100	27100	30200	33200	36200	39200	42100	45200	48200
24			26000	28900	31800	34700	37600	40400	43400	46200
25			25000	27700	30500	33300	36000	38800	41600	44300
26				26700	29400	32000	34700	37300	40000	42700
27				25700	28300	30800	33400	36000	38600	41100
28					27300	29700	32200	34600	37200	39600
29					26300	28700	31100	33500	35900	38300
30					25400	27700	30000	32300	34700	37000
31						26800	29100	31300	33600	35800
32						26000	28200	30300	32500	34700
33							27300	29400	31500	33600
34							26500	28500	30600	32600
35							25800	27700	29700	31700
36								27000	28900	30800
37								26200	28100	30000
38									27400	29200
39									26700	28500
40									26000	27700
41										27100
42										26400



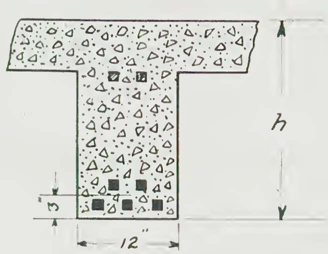
h = Total depth of Beam in inches

$$B.M. = \frac{wl}{8}$$

N.B. If beams are continuous over several supports, above loads may be increased 25%

TOTAL SAFE LOADS
IN POUNDS
UNIFORMLY DISTRIBUTED
FOR
REINFORCED CONCRETE BEAMS
5 - 1⅛" - "**KLUTCH**" BARS
AREA = 6·3□"

SPAN IN FEET	Depth in Inches = h.						
	24	26	28	30	32	34	36
24	50500	55300	60000	65000	69700	74500	79400
25	48500	53000	57700	62300	67000	71500	76300
26	46600	51000	55500	60000	64400	68900	73300
27	45000	49100	53400	57700	62000	66300	70500
28	43400	47400	51500	55600	59700	63900	68000
29	41800	45800	49700	53700	57700	61700	65700
30	40400	44200	48100	52000	55800	59700	63500
31		42800	46500	50200	54000	57700	61500
32		41500	45000	48700	52300	56000	59500
33			43700	47200	50700	54200	57700
34			42400	45800	49200	52600	56000
35			41200	44500	47800	51200	54500
36				43300	46500	49700	53000
37				42100	45200	48400	51500
38					44000	47100	50100
39					43000	45800	48900
40					41800	44800	47600
41						43700	46500
42						42600	45400



h = Total depth of Beam in inches.

$$B.M. = \frac{wl}{8}$$

N.B. = If beams are continuous over several supports, above loads may be increased 25%

Canadian Bank of Commerce Building, Montreal. Messrs. Darling & Pearson, Architects.
"Steelcrete" Reinforcement and Lath.

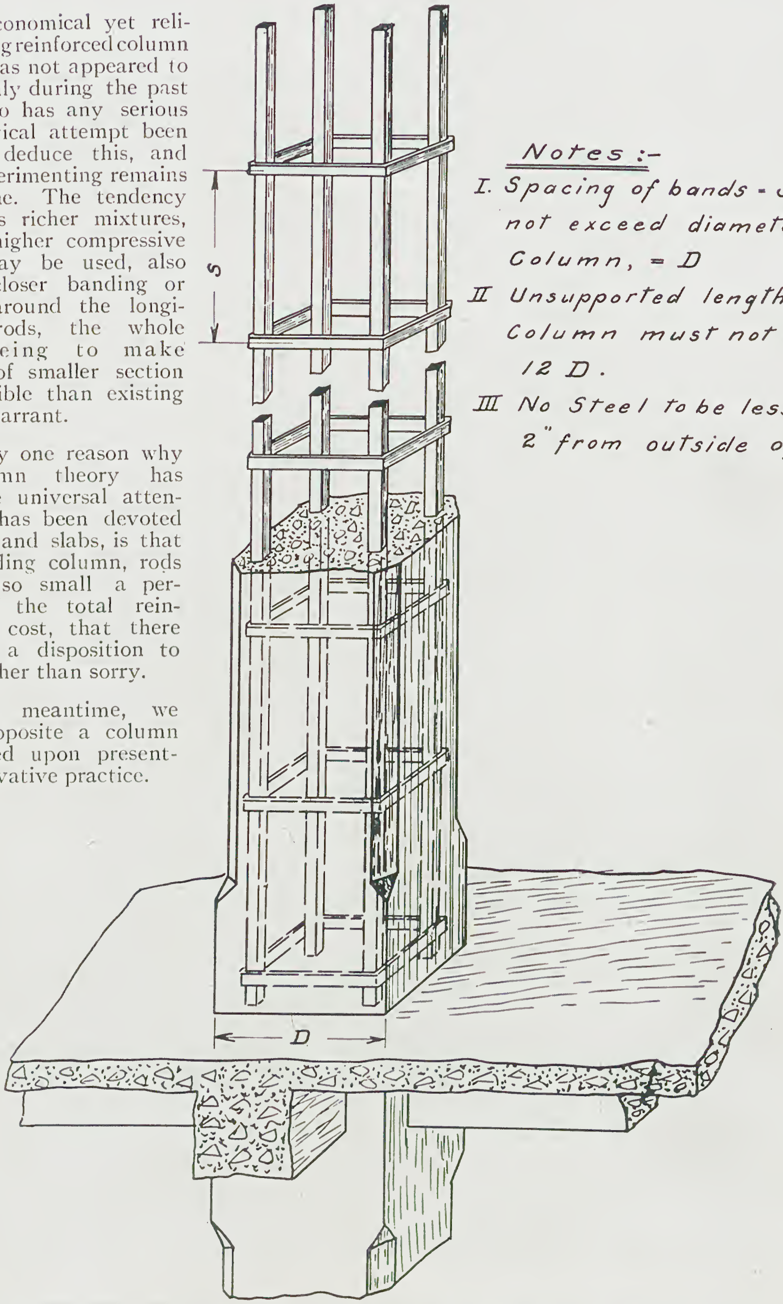
Interior view of a warehouse showing floor designed in Steelcrete Construction.

REINFORCED CONCRETE COLUMNS

The economical yet reliably strong reinforced column formula has not appeared to date. Only during the past year or so has any serious and practical attempt been made to deduce this, and much experimenting remains to be done. The tendency is towards richer mixtures, so that higher compressive values may be used, also towards closer banding or winding around the longitudinal rods, the whole effort being to make columns of smaller section more feasible than existing formulæ warrant.

Probably one reason why the column theory has lacked the universal attention that has been devoted to beams and slabs, is that in a building column, rods represent so small a percentage of the total reinforcement cost, that there has been a disposition to be sure rather than sorry.

In the meantime, we include opposite a column table based upon present-day conservative practice.



Notes :-

I. Spacing of bands = S must not exceed diameter of Column, = D

II Unsupported length of Column must not exceed 12 D.

III No Steel to be less than 2" from outside of Col.

SAFE LOADS IN POUNDS FOR CONCRETE COLUMNS REINFORCED WITH "KLUTCH" BARS

Working Stresses	Size of Columns	REINFORCEMENT 4 – 1/2"	4 – 5/8"	4 – 3/4"	4 – 7/8"	4 – 1"	4 – 1 1/8"	4 – 1 1/4"
Concrete 500 lbs. Steel 7500 lbs	10 x 10	57500	61700	66875	72975	80000	87975	96875
	12 x 12	79500	83700	88875	94975	102000	109975	118875
	14 x 14	105500	109700	114875	120975	128000	135975	144875
	16 x 16	135500	139700	144875	150975	158000	165975	174875
	18 x 18	169500	173700	178875	184975	192000	199975	208875
	20 x 20	207500	211700	216875	222975	230000	237975	246875
	22 x 22	249500	253700	258875	264975	272000	279975	288875
	24 x 24	295500	299700	304875	310975	318000	325975	334875
	26 x 26	345500	349700	354875	360975	368000	375975	388875
	28 x 28	399500	403700	408875	414975	422000	429975	438875
	30 x 30	457500	461700	466875	472975	480000	487975	496875
	32 x 32	519500	523700	528875	534975	542000	549975	558875
	34 x 34	585500	589700	594875	600975	608000	615975	624875
	36 x 36	655500	659700	664875	670975	678000	685975	694875
Concrete 600 lbs. Steel 9000 lbs.	10 x 10	69000	74075	80250	87575	96000	105575	116250
	12 x 12	95400	100475	106650	113975	122400	131975	142650
	14 x 14	126600	131675	137850	145175	153600	163175	173850
	16 x 16	162600	167675	173850	181175	189600	199175	209850
	18 x 18	203400	208475	214650	221975	230400	239975	250650
	20 x 20	249000	254075	260250	267575	276000	285575	296250
	22 x 22	299400	304475	310650	317975	326400	335975	346650
	24 x 24	354600	359675	365850	373175	381600	391175	401850
	26 x 26	414600	419675	425850	433175	441600	451175	461850
	28 x 28	479400	484475	490650	497975	506400	515975	526650
	30 x 30	549000	554075	560250	567575	576000	585575	596250
	32 x 32	623400	628475	634650	641975	650400	659975	670650
	34 x 34	702600	707675	713850	721175	729600	739175	749850
	36 x 36	786600	791675	797850	805175	813600	823175	833850

FOUNDATIONS AND FOOTINGS

In the development of footings and foundations in general, where from the nature of the soil it is necessary to increase the bearing area and at the same time economize space, the practice has advanced from the old style of wooden crib work through numerous stages to plain concrete and footings of steel rails or beams imbedded in concrete. These two forms, while possessing infinite advantages over the preceding methods, are nevertheless susceptible of further improvement. In footings of steel beams incased in concrete, the latter is merely a binding and protecting material, in many cases reinforced concrete is preferable and decidedly more economical than the steel beam form, as in the former the metal may be placed to work to the greatest advantage in resisting tensiona stresses and the concrete is utilized for resisting compressive stresses. In every instance the introduction of Expanded Metal in connection with the beams, may be shown to be a decided benefit toward securing both an equalization of the load and an economical construction. In plain concrete footings, the projection of the footing courses are compar atively small, necessitating a series of courses to obtain the desired spread This in turn requires a greater depth of concrete, more excavation and in many cases, valuable cellar space is occupied by the footing courses. All of these disadvantages may be eliminated by the introduction of Expanded Metal Reinforcement into the concrete. Generally speaking a reinforced concrete footing designed for given conditions of loading, will be approximately one-fourth the depth of a plain concrete footing designed under the same conditions and will cost from 15 to 25 per cent. less. In addition, there is saving of space and increased safety, the unreliable tensile strength of plain concrete having been replaced by a reliable tension member of metal.

In foundations where piles are driven and capped with concrete inserting Expanded Metal materially reduces the thickness of concrete and insures an equal distribution of pressure.

In many instances where continuous and deep foundations would otherwise be necessary, clusters of piles may be driven or piers erected, at suitable intervals, and the latter spanned by comparatively shallow reinforced concrete girders, upon which the superstructure may be erected direct, resulting in a substantial saving of time, labor and material.

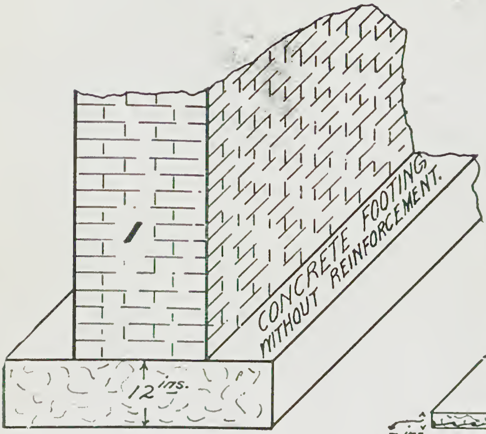
FOUNDATIONS AND FOOTINGS

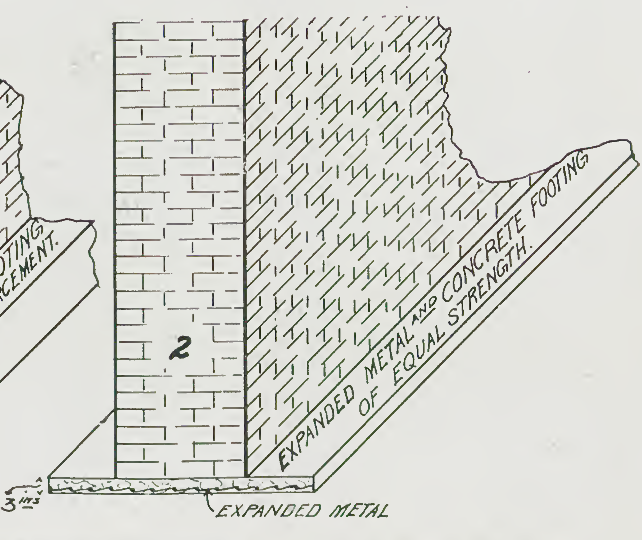
Size of Footings and Reinforcement Required for Various Loads and Soil Values.

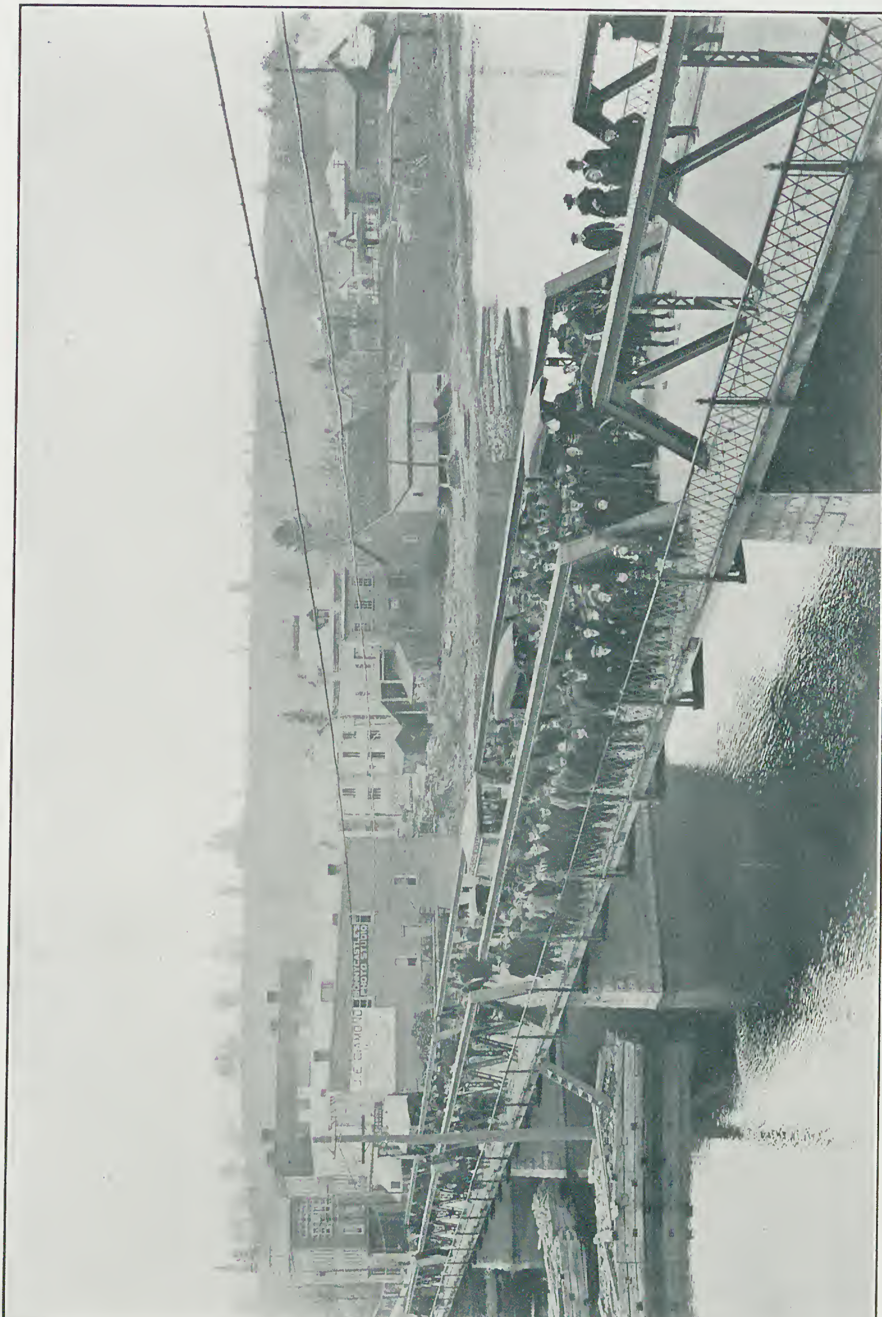
Soil Value	4000 lbs.			5000 lbs.			6000 lbs.		
Load on Ftg	Size of Footing	Depth of Footing	K-Bars	Size of Footing	Depth of Footing	K-Bars.	Size of Footing	Depth of Footing	K-Bars.
75000	4'-6" Sq	1'-0"	8-7/8"	4'-0" Sq	1'-0"	8-7/8"			
100000	5'-0"	1'-0"	10-7/8"	4'-6"	1'-0"	10-7/8"	4'-3" Sq.	1'-0"	10-7/8"
125000	5'-9"	1'-2"	8-1"	5'-0"	1'-0"	8-1"	4'-9"	1'-0"	10-7/8"
150000	6'-3"	1'-3"	10-1"	5'-6"	1'-1"	8-1"	5'-0"	1'-0"	8-1"
175000	6'-9"	1'-4"	12-1"	6'-0	1'-2"	10-1"	5'-6"	1'-1"	10-1"
200000	7'-3	1'-5"	12-1"	6'-6	1'-3"	12-1"	5'-9"	1'-2"	10-1"
225000	7'-6	1'-6"	14-1"	6'-9	1'-4"	12-1"	6'-3"	1'-3"	10-1"
250000	8'-0	1'-7"	16-1"	7'-3"	1'-5"	14-1"	6'-6"	1'-4"	12-1"
275000	8'-6"	1'-8"	16-1"	7'-6	1'-6"	16-1"	6'-9"	1'-4"	14-1"
300000	8'-9"	1'-9"	18-1"	7'-9	1'-7"	16-1"	7'-3"	1'-5"	16-1"
325000	9'-0"	1'-10"	20-1"	8'-0	1'-7"	16-1"	7'-6"	1'-6"	16-1"
350000	9'-6	1'-11"	20-1"	8'-6"	1'-8"	18-1"	7'-9"	1'-7"	18-1"
375000	9'-9"	1'-11"	22-1"	8'-9	1'-9"	18-1"	8'-0"	1'-7"	18-1"
400000	10'-0	2'-0"	24-1"	9'-0"	1'-10"	18-1"	8'-3"	1'-8"	18-1"
425000	10'-3	2'-1"	26-1"	9'-3"	1'-10"	22-1"	8'-6"	1'-9"	18-1"
450000	10'-9"	2'-2"	28-1"	9'-6"	1'-11"	22-1"	8'-9"	1'-9"	22-1"
475000	11'-0	2'-2"	28-1"	9'-9"	1'-11"	26-1"	9'-0"	1'-10"	22-1"
500000	11'-3	2'-3"	30-1"	10'-0"	2'-0"	28-1"	9'-3"	1'-10"	22-1"
525000	11'-6"	2'-3"	30-1"	10'-3"	2'-1"	28-1"	9'-6"	1'-11"	22-1"
550000	11'-9	2'-4"	32-1"	10'-6"	2'-1"	30-1"	9'-9"	1'-11"	26-1"
575000	12'-0	2'-5"	32-1"	10'-9"	2'-2"	30-1"	9'-9"	1'-11"	28-1"
600000	12'-3	2'-6"	34-1"	11'-0"	2'-2"	32-1"	10'-0"	2'-0"	28-1"

ALLOWABLE LOAD ON SOIL
Tons per Square Foot

Gravel and Course Sand, well cemented .... 8 tons
Dry, Hard Clay .... 4 "
Sand, compact and well cemented .... 4 "
Moderately Dry Clay, or Clear Dry Sand .... 2 "
Soft, Wet Clay .... 1 "
Quick Sand or Alluvial Soils .... ½ "



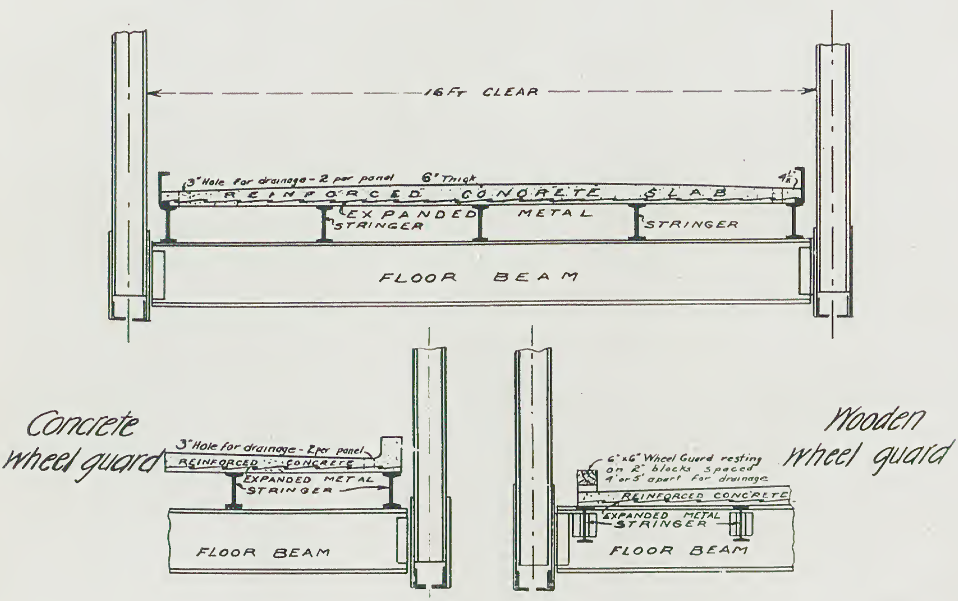


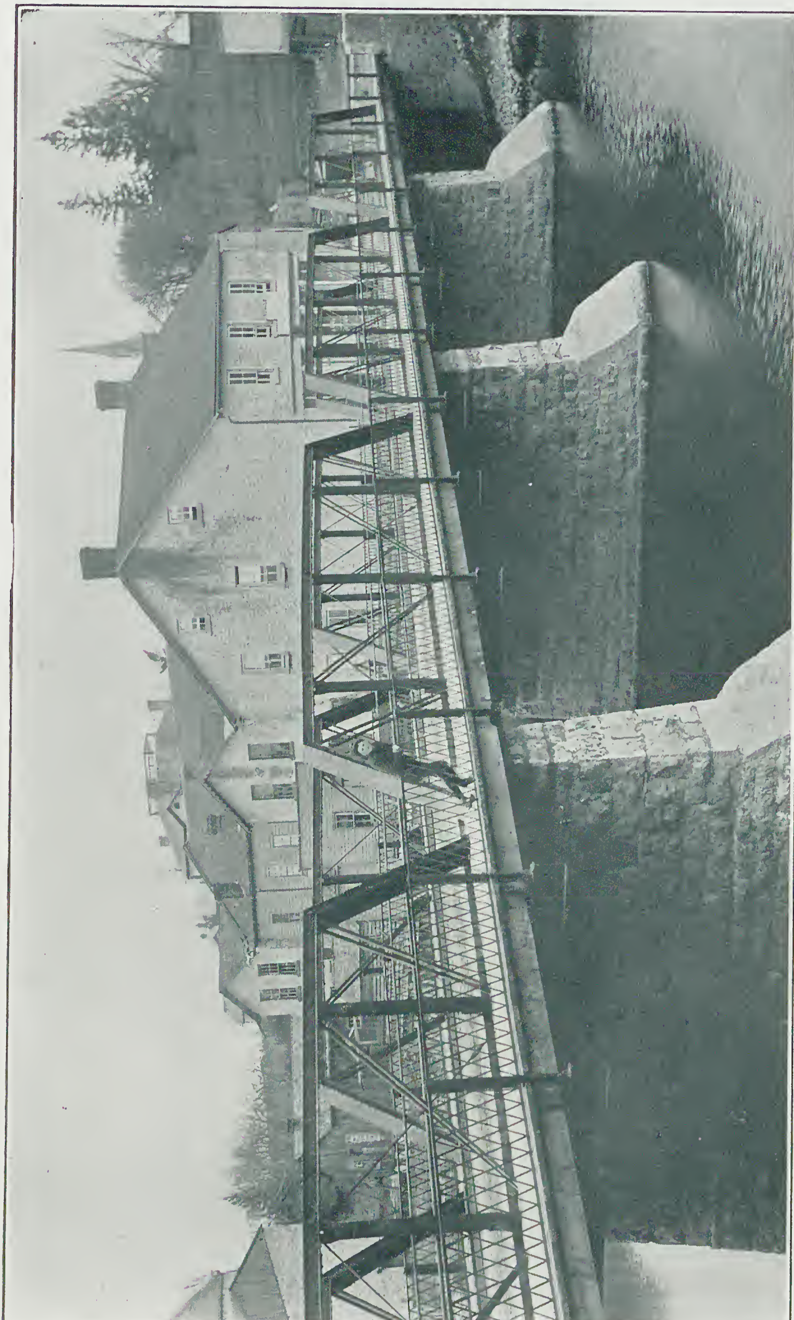


Campbellford Bridge, completed Nov. 23, 1904. Mr. R. Weddell, Trenton, Engineer and Contractor.
"Steelcrete" reinforced floor.

HIGHWAY BRIDGES

The proper place for a traction engine is not in the creek. The "Humpty Dumpty" bridge, as the wood structure of our father's time was called, is rapidly becoming obsolete. Steel is replacing timber, Reinforced Concrete decks superseding pine. A Canadian bridge engineer of many years' experience, states that a steel bridge becomes to the township or county, an actual saving after a comparatively short period, so that the usual trouble, now-a-days, is deciding between wood joists with wood covering, and a permanent deck. As to the actual percentage of increased cost of crossing a stream with a permanent roadway, over the cost of a steel bridge with wood joists and cover, he takes as a typical case, a 90 foot span and 16 foot roadway with 100 lbs. per sq. ft. live load, and he states that there will be 41% increase for the superstructure; and (adopting the accepted rule of economic bridge design that the superstructure and substructure costs should be equal) the actual excess of money required to make the crossing permanent **for all time,** will be half 41%, or 20½%.





Victoria Bridge, Elora, Ont. Messrs. Bowman & Connor, Engineers. Steelcrete Floor Reinforcement.

HIGHWAY BRIDGES

The full meaning of this fact is now coming home to the taxpayers of county and township, as the number of permanent bridges being erected annually, pointedly attests. Calculating the maintenance cost for a period of 19 years, with a bridge of size above, this excess of 41% will entirely disappear. A wood covering demands renewal every six years. It can be shown, moreover, that the wood structure compared in the manner described, would actually be insufficiently strong for ordinary cases of heavy concentrated loading. All this in face of the weight of the permanent deck per lineal floor, for a 16 foot roadway bridge, being 1000 lbs. as against 150 lbs. for 3 inch pine, or an increase of 53 lbs. per square foot, equivalent to 27 lbs. of moving load. Brick arches, terra cotta arches, concrete arches, corrugated iron arches, buckle plates or trough plates with concrete or gravel covering were all tried out as permanent bridge floorings, but Reinforced Concrete alone survives as furnishing the greatest strength at the least cost, with the least amount of superimposed dead load on the bridge.

The steel joists vary from 9 inches to 12 inches in depth, depending upon the length of the panel of the bridge truss and the weight of the traction engine called for, the lightest being assumed at 10 tons, and heaviest at 25 tons. The distance apart, centre to centre of joists, seldom is less than 3 feet 3 inches, nor more than 4 feet 3 inches. The plate usually is 6 inches thick at crown, decreasing to 4½ inches at outer limits of roadway.

In all parts of the world, "Steelcrete" Expanded Metal occupies a position by itself among bridge engineers and commissioners, as the best available reinforcement for concrete. It possesses an absolute mechanical bond against vibration.

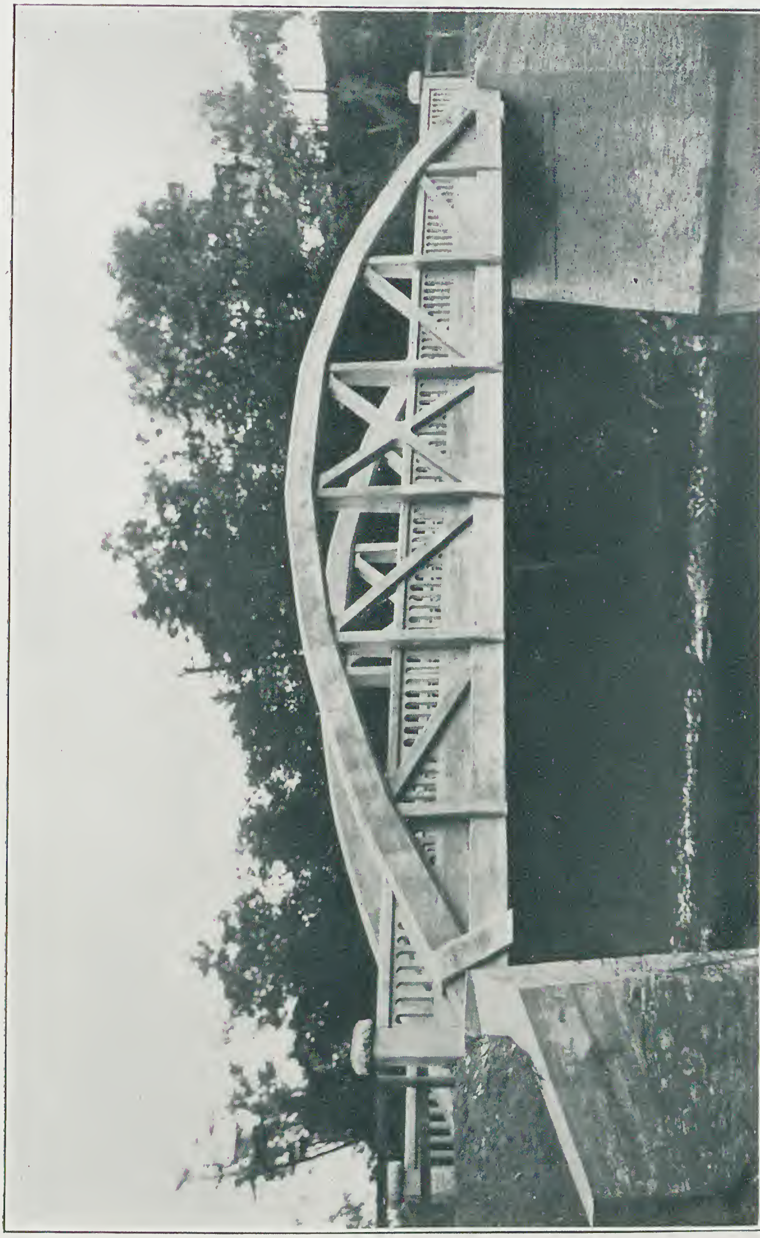
The Reinforced Concrete designer goes farther. He points out that a bridge, as it were, has no friends; that it must withstand the elements and all that implies, also the utmost severity of continuous repeated loading —concentrated and moving loading. He presents proof that the all-reinforced bridge is best adapted to these conditions. Lighter than massive concrete, it affords the same advantages of permanence without maintenance charges, also of being constructed with materials ready to hand, even at out-of-the-way sites. The designing can be done with the exactitude of a steel or timber bridge.

In ordinary practice, spans up to 18 ft. or 20 ft. can be treated as a flat reinforced slab resting on abutments. For greater spans up to 40 ft. or 45 ft., Reinforced Concrete beams are provided to support a lighter reinforced slab which spans at right angles between the beams. The two outer beams come to rest at the abutments, the slab is dropped down to the full depth of the beam, to give better bearing

Spans past the limit last mentioned are most economically treated on the arch principle. Engineers are invited to correspond with our designing department concerning any work on hand.

A TYPICAL Ontario highway bridge, one of thousands throughout the Dominion. This one spans the Grand River near St. Jacobs, Ont. Mr. H. J. Bowman, Berlin, Engineer. Was built by the Hamilton Bridge Works Co., Ltd. "Steelecrete" floors as usual.

ON the opposite page, an illustration is given of the first Reinforced Concrete Truss Bridge (Messrs. Barber & Young, Engineers, Toronto) to be built in Canada, and one of the first in America. The Contractors, Messrs. O. L. Hicks and Son, Humber Bay, Toronto, completed the erection in October, 1909. Plain, round rods were used for the trusses, beams and hand rail, while "Steelecrete" Expanded Metal was utilized in the floor slab. This interesting structure, which is on the Middle Road joining York and Peel Counties, Ont., over the Etobicoke River, was tested out on the opening day by the severest load for a highway bridge, consisting of a densely packed herd of rearing, trampling cattle, the whole weighing not less than 35 tons. This eminently practical test load failed to produce more than a tremor. Span, 82 feet centre to centre of bearings; roadway, 15 feet, 2 inches; height of floor above water, 16 feet; weight of superstruction, 200 tons; superstructure cost $3,190.



STEELECRETE Expanded Metal Reinforcement for bridge floors has been very largely used throughout every township, county and province, where good roads and permanent bridges are in evidence. Space does not allow of our listing these structures; suffice it to say that they are on every good "pike."

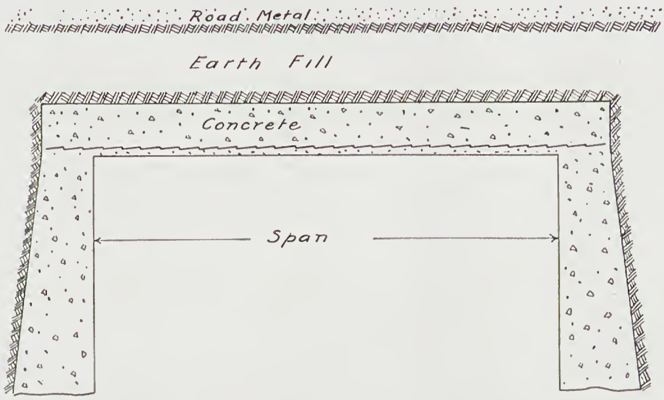
CULVERTS

Gravel can be found very nearly everywhere. This is one reason why open culverts, box culverts, double culverts, etc., are universally replacing those of timber. They are cheaper than stone. Once built, they increase in strength. There is no outlay for maintenance. They may be designed to suit any condition or amount of fill and for any quality of foundation. In this style of construction, any settlement, arising from bad bottom, may be guarded against absolutely, at practically no cost. Where wing walls or aprons are necessary, the entire structure can be monolithic, each part rigidly united and giving stability to be attained with no other material. Always remember that, given the same knowledge of local conditions, Reinforced Concrete designing to meet any contingency of load, pressure, etc., can be relied upon with the same certainty as with other materials.

Railroad box culverts are commonly built of reinforced Concrete. Massive concrete is wasteful. The greater the loading to be contended with, the more pronounced becomes the economy of using steel reinforcement.

Engineers who demand in their work that the reinforcement shall have an absolute mechanical bond against vibration, specify heavy Expanded Metal, either with or without rods, as the span and depth of fill may determine for the culvert tops, also in the floor plate, if a poor bearing value of soil calls for a firm, distributed footing.

Covers for Highway Culverts



Highway Culvert Covers

12 Ton Road Roller

		Depth of Fill													
		6" to 1'-0"		2'-0" to 3'-0"		4'-0"		5'-0"		6'-0"		7'-0"		8'-0"	
		Slab	Plate Number	Slab	Plate Number	Slab	Plate Number	Slab	Plate Number	Slab	Plate Number	Slab	Plate Number	Slab	Plate Number
Clear Span	4	6"	31025	6"	31035	6"	31035	6"	31035	6"	31035	6"	31035	6"	31035
	5	7"	31035	7"	do	7"	do	7"	do	7"	do	7"	3640	7"	3640
	6	8"	do	8"	do	8"	do	8"	3640	8"	3640	8"	3650	8"	3650
	7	9"	do	9"	3640	9"	3640	9"	3650	9"	3650	9"	do	9"	do
	8	10"	do	10"	do	10"	3650	10"	do	10"	do	10"	3660	10"	3660

20 Ton Road Roller

		Depth of Fill													
		6" to 1'-0"		2'-0" to 3'-0"		4'-0"		5'-0"		6'-0"		7'-0"		8'-0"	
		Slab	Plate Number	Slab	Plate Number	Slab	Plate Number	Slab	Plate Number	Slab	Plate Number	Slab	Plate Number	Slab	Plate Number
Clear Span	4	7"	3650	7"	3660	7"	3660	7"	3660	7"	3660	7"	3660	7"	3660
	5	8"	3660	9"	do	9"	do	9"	do	9"	do	9"	do	10"	do
	6	12"	3650	12"	3650	12"	3650	12"	do	12"	do	12"	do	12"	do
	7	14"	do	14"	do	14"	3660	14"	do	14"	do	14"	do	14"	do
	8	16"	do	16"	3660	16"	do	16"	do	18"	do	18"	do	18"	do

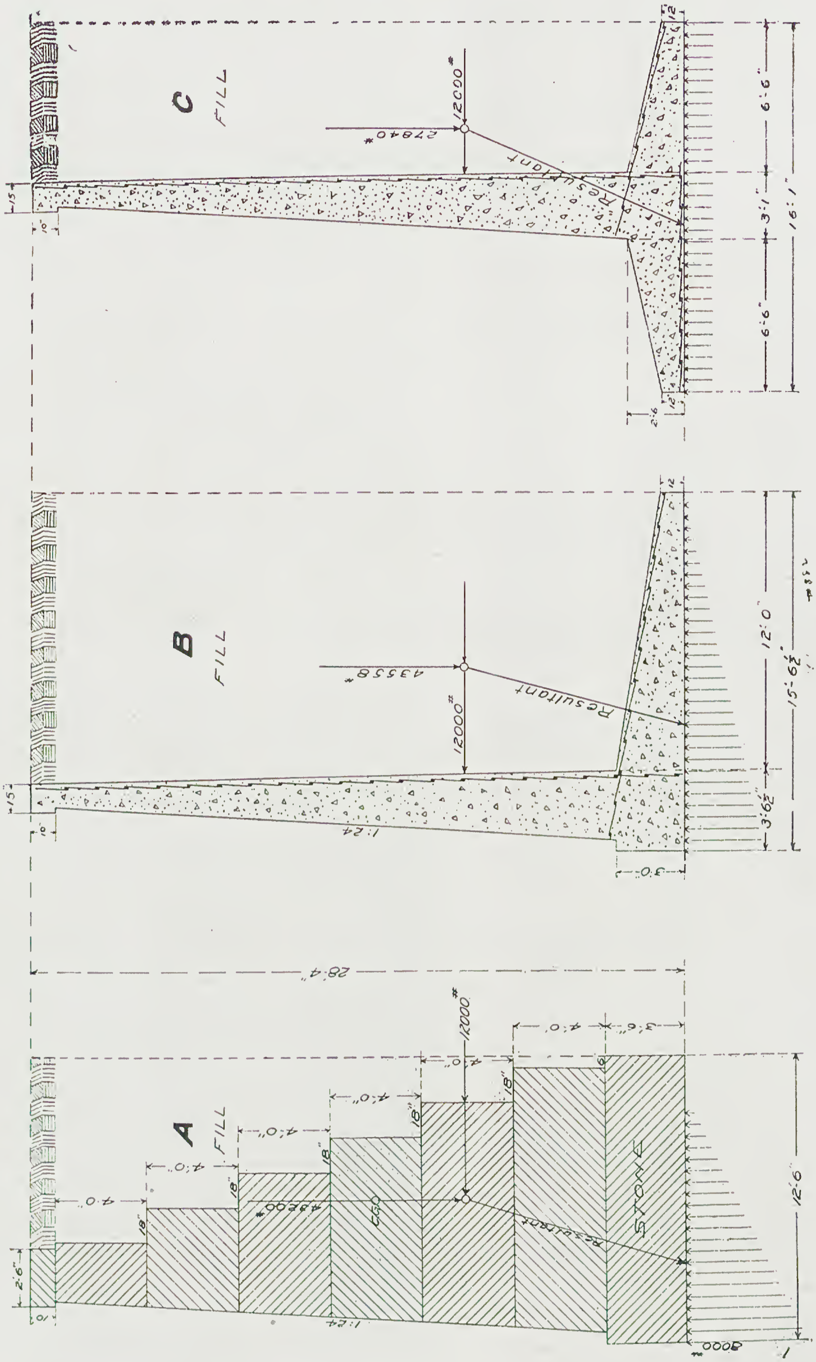
RETAINING WALLS

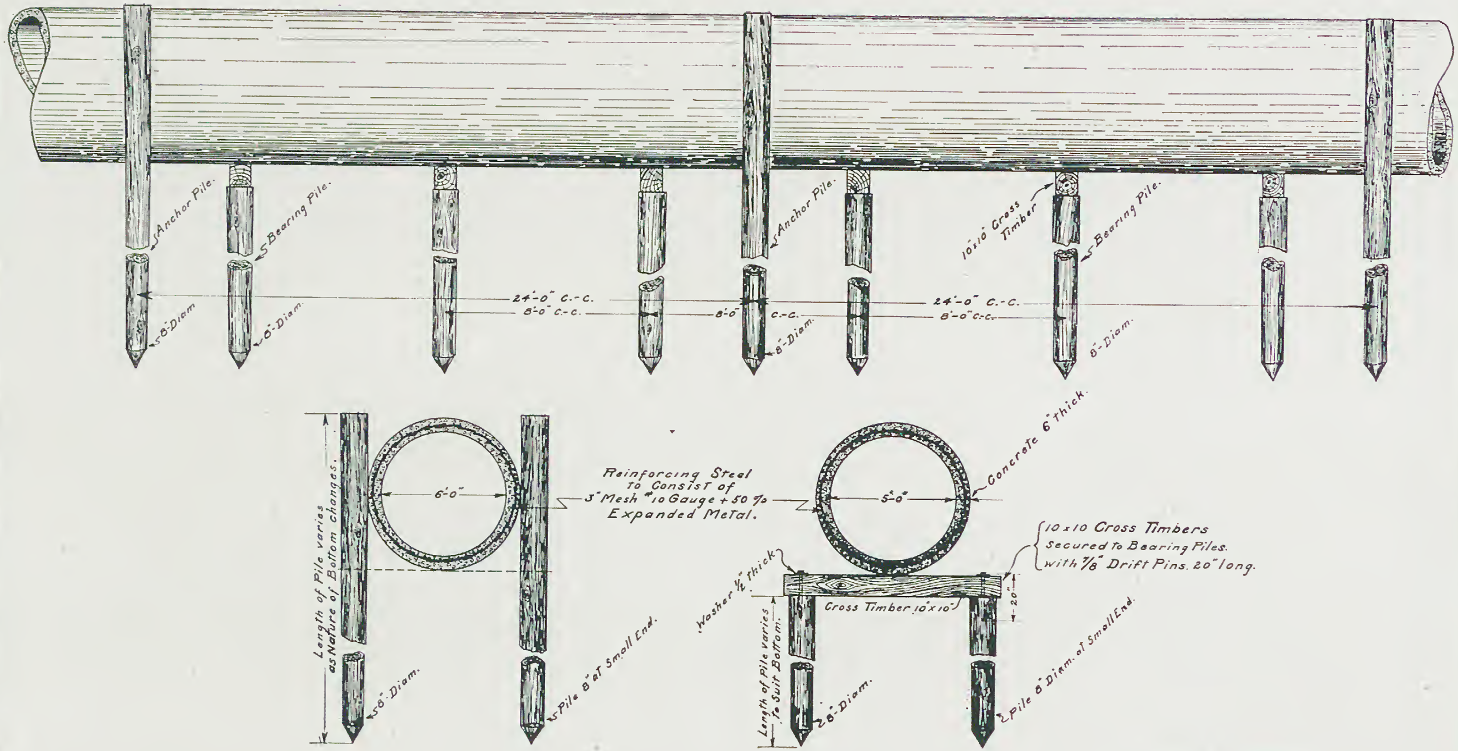
Reinforced Concrete retaining walls are cheaper than the historic gravity type, and the higher the wall may be, the more pronounced becomes the economy, from 25% to 50% frequently being attained. It has been said that an engineer who has once designed and supervised construction in this modern type, thereafter will regard a gravity wall as a makeshift, a clumsy and wasteful mass, much given to annoying cracks.

Perfect immunity from shrinkage, temperature and settlement cracks can be guaranteed if the structure be built of Reinforced Concrete from detail plans which have been intelligently thought out in the design. The problem is to achieve a sufficiently strong combination of steel and concrete, these materials performing their functions of resistance of tensile and compressive stresses respectively, to form a vertical member joined at its base to a horizontal member upon which bears down the filling that keeps the rigid whole from overturning. The old familiar conditions of earth pressures, drainage, etc., still have to be considered, and the "Middle Third" dealt with, the wall still has to resist both overturning and sliding, yet the problem is not one of sufficient weight but rather of sufficient strength of two materials acting in accord (the area of base being common to both types). After all, the design comes down to merely combining different applications of the simple theory of the Reinforced Concrete beam, with several bending moments to consider, and corresponding moments of resistance to compute.

Retaining walls of cantilever type are economical for heights up to about 18 ft., and buttresses should be resorted to for anything higher. Heavy Expanded Metal alone or in combination with rods, is widely specified in the face wall and base slabs of both types. As would be expected from the similarity of conditions Expanded Metal is equally adapted to

Reinforced Concrete Reservoirs, Tanks, Dams, Foundations, Piers, Sewers, Bridges, Subways, Flumes, Tunnels, Conduits, Vaults, Cisterns, Septic Tanks, Storage Bins, Dry Kilns, Coal Bunkers, Dry Docks, Fortifications, Power Plants, Warehouses, Storage Houses, Factories, Sidewalks, Deck Houses, Domes, Floors, Roofs, Etc.


C
FILL
12000#
27840#
Resultant
6'6"
3'1"
16'1"
B
FILL
43558#
12000#
Resultant
1:24
12'0"
15'6½"
3'6½"
3'0"
28'4"
A
FILL
43200#
12000#
Resultant
STONE
4'0"
18"
1:24
2'6"
12'6"
3'6"
8000#



CITY OF TORONTO

SEWAGE DISPOSAL WORKS

DETAIL OF CONCRETE OUTFALL SEWER

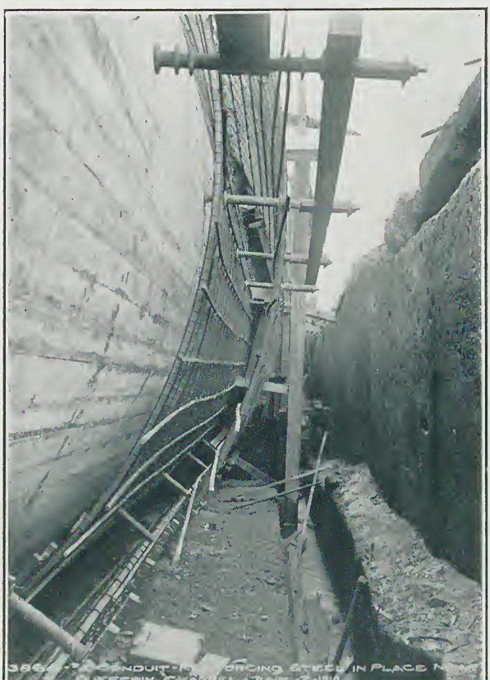
Scale-Half-Inch = 1-Foot.

SEWERS AND AQUEDUCTS

Actual tests show that Expanded Metal is the ideal material for reinforcing concrete sewers, aqueducts, conduits, etc. Where the sewer is over three feet in diameter, steel reinforcement, by common assent among engineers, is resorted to. More particularly is this the case where the construction in not *in situ*, but calling for sections of a length to be readily handled and lowered to its place in the trench. Expanded Metal reinforces every part of pipe, every part alike, and will lock the separate sections together.

The detail drawings opposite, indicate construction methods for the Reinforced Concrete out-fall sewer in connection with the City of Toronto Sewerage Disposal Works, according to specifications of Mr. C. H. Rust, City Engineer. The contractors were required to state in their tender, the kind and make of reinforcement they proposed to use. The work was let to E. W. Hyde, Jr., Engineer Contractor, Toronto, and the pipe as constructed was reinforced with Plate No. 31030 "Steelcrete" Expanded Metal.

No. 2 CONDUIT
THE ONTARIO POWER CO. OF NIAGARA FALLS

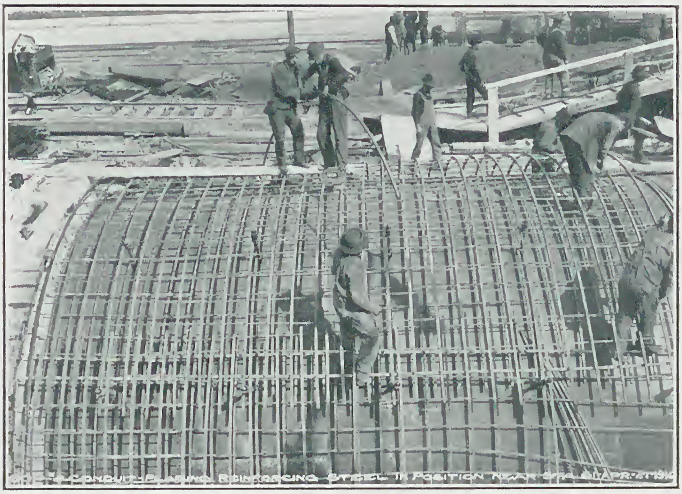


We are indebted to the Ontario Power Company of Niagara Falls for the accompanying photographs and data re this large and interesting undertaking.

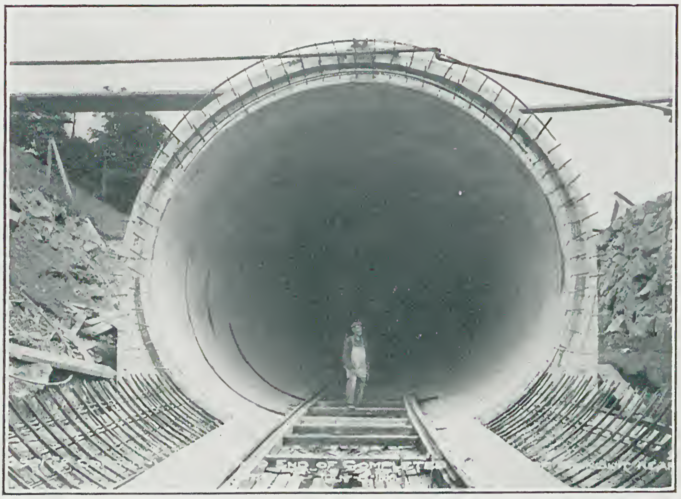
The conduit is approximately 6,300 ft. in length. It is of an oblate shape with dimensions of $16\frac{1}{2}$ ft. on vertical axis, $19\frac{1}{4}$ ft. on horizontal axis; with a cross sectional area of 254 sq. ft., which is the equivalent of an 18 ft. diameter circular conduit. Concrete is 18 inches in thickness. Approximately 2,500 tons of "Klutch" reinforcing bars and 40,000 cubic yards of concrete were used. The conduit was designed and built by the Ontario Power Company,

No. 2 Conduit Data

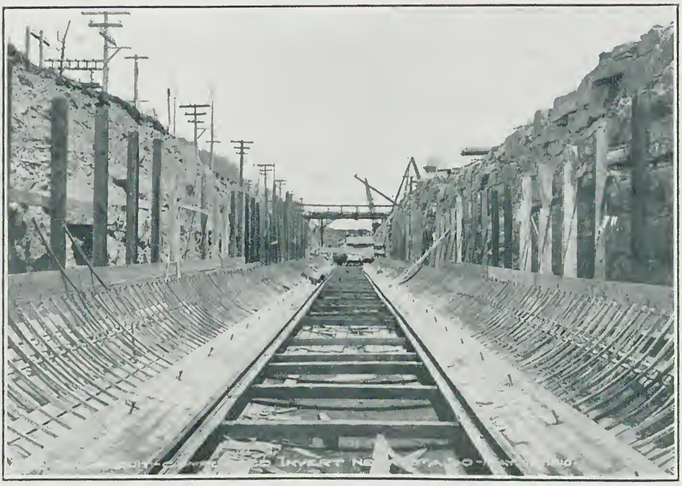
Continued



Mr. V. G. Converse, Engineer-in-Charge, its construction being started on February 18th, 1910, and completed on July 19th, 1910. It

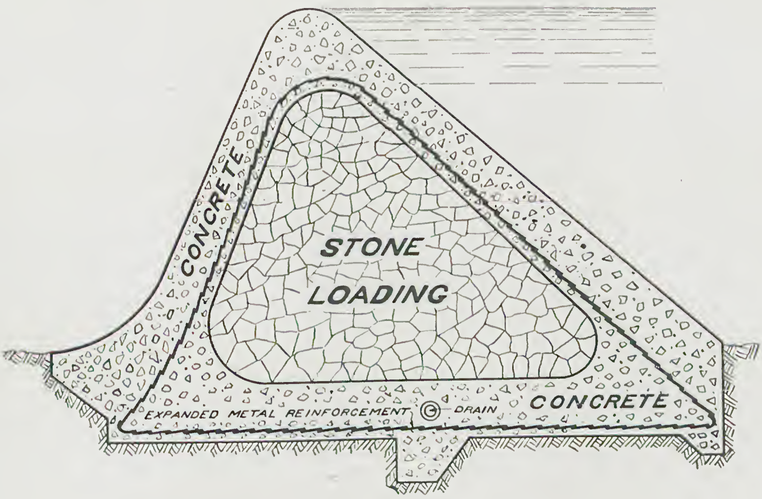


will supply a sufficient quantity of water to operate six 12,000 H.P. turbine-driven generators.



DAM CONSTRUCTION

The illustration given of a hollow concrete dam reinforced with "Steelcrete" Expanded Metal, indicates a development in dam construction which although of comparatively recent date, has nevertheless been thoroughly tried out. There are several companies now operating, claiming patent rights. As will be seen, the main feature is a great saving in concrete over the old fashioned gravity dam, this being effected by means of a thin reinforced wall, roughly triangular in section, weight being given to the structure by stone loading within the steel.



A COLLECTION OF ODDS AND ENDS EASILY FORGOTTEN

INCHES—Expressed in Terms of a Foot

		1/8	1/4	3/8	1/2	5/8	3/4	7/8
0	....	.01	.02	.03	.04	.05	.06	.07
1	.08	.09	.10	.11	.125	.135	.145	.156
2	.166	.177	.187	.197	.208	.218	.229	.239
3	.250	.26	.27	.28	.29	.30	.31	.32
4	.333	.34	.35	.36	.375	.385	.395	.406
5	.416	.427	.437	.447	.458	.468	.479	.489
6	.50	.51	.52	.53	.54	.55	.56	.57
7	.58	.59	.60	.61	.625	.635	.645	.656
8	.666	.677	.687	.697	.708	.718	.729	.739
9	.75	.76	.77	.78	.79	.80	.81	.82
10	.83	.84	.85	.86	.875	.885	.895	.906
11	.916	.927	.937	.947	.958	.968	.979	.989

ASTRONOMICAL and NAVIGATION

60 seconds = 1 minute.
60 minutes = 1 degree.
90 degrees = 1 right angle,
360 degrees = 1 circle.

MISCELLANEOUS

12 units = 1 dozen,
12 dozen = 1 gross, gro.,
12 gross = 1 great gross, gt. gro.,
20 units = 1 score,
720 feet = 1 cable's length.
Area of Circle = sq. of diameter x .7854,
Circumference = dia. of circle x 3.1416,
Area of triangle = Base x ½ height,
Area of ellipse = Product of diameters x .7854,
Area of trapezoid = height x ½ sum of parallel sides,
Surface of sphere = circumference x dia.,
Contents of sphere = surface x 1-6 dia.,
Contents of cone = area of base x 1-3 perpendicular height.

PAPER

24 sheets = 1 quire, qr.,
20 quires = 1 ream, 1 rm.,
2 reams = 1 bundle,
5 bundles = 1 bale.

1 Quintal Fish	100 lbs.
1 Barrel Flour	196 "
1 Barrel Salt	280 "
1 Central	100 "
1 Barrel Pork	200 "
1 Barrel Beef	200 "
1 Keg Powder	25 "
1 Pig of lead or iron—21½ stone	301 "

WEIGHT OF A WINCHESTER BUSHEL IN POUND AVOIRDUPOIS

Apples, dried	22 lbs.
Anthracite	80 "
Barley	48 "
Beans	60 "
Beets	60 "
Bituminous Coal	76 "
Bran	20 "
Buckwheat	48 "
Carrots	60 "
Cement, Rosendale Hydraulic	76 "
Cement, Portland	96 "
Charcoal, Hardwood	30 "
Clover Seed	60 "
Coke	40 "
Corn, in ear	70 "
Corn, shelled	56 "
Flax Seed	56 "
Hemp Seed	44 "
Lime, loose	70 "
Malt	38 "
Oats, U.S	32 "
Oats, Canada	34 "
Onions	60 "
Peas	60 "
Potatoes	60 "
Rye	56 "
Salt	56 "
Timothy Seed, U.S.	45 "
Timothy Seed, Canada	48 "
Turnips	60 "
Wheat	60 "

LUMBER

Sawn lumber and timber is almost universally sold in Canada by Board Measure. The foot board measure is the equivalent of a board 12 in. long x 12 in. wide, and 1 in. thick, and is denoted 1 ft. B.M. To find the contents of sawn lumber or timber in feet B.M., multiply the length in inches by the width in inches by the thickness in inches, and divide by 144. If the length is in feet, divide by 12. Illustration:—Given 1 board 12 ft. long x 10 in. wide x 1 in. thick, we have $\frac{12\text{x}10\text{x}1}{12} = 10$ ft. B.M. Or, given a stick 20 ft. long x 10 in. wide, 8 in. thick, we have $\frac{20\text{x}10\text{x}8}{12} = 133\frac{1}{3}$ ft. B.M.

Logs and round timber are generally purchased and sold by board measure. Rule:—From the diameter of the log in inches deduct 4 and multiply the remainder by ½ of itself, multiply that product by the length of the log and divide by 8; the quotient is the feet B.M., required. If the log is over 30 ft. long, find the average diameter; if less, take diameter at small end only.

Shingles—Best are of white cedar. Shingles are packed 250 to the bundle, or 4 bundles to 1000.

1 bundle 16 in. Shingles will cover 30 sq. ft.
1 bundle 18 in. shingles will cover 33 sq. ft

FOR OBTAINING APPROXIMATE WEIGHT OF IRON FOR ROUND BARS

RULE:—Multiply the square of the diameter in inches by the length in feet, and that product by 2.6. The product will be the weight in pounds, nearly.

FOR SQUARE AND FLAT BARS

RULE:—Multiply the area of the end of the bar in inches by the length in feet, and that by 3.32. The product will be weight in pounds nearly.

RAINFALL

1 in. rainfall per hr. = 1 cub. foot per second per acre.

Inches of rainfall x 2,323,200 = cub. feet per sq. mile.

Inches of rainfall x 14½ = millions of gallons per sq. mile.

MISCELLANEOUS

6 feet = 1 fathom, water measurement,
1 15-100 statute mile = 1 geographical mile, nautical.
3 geographical miles = 1 league.
60 geographical miles = 1 degree.

SQUARE MEARSURE

144 square inches	= 1 square foot,
9 square feet	= 1 square yard,
30¼ square yards	= 1 square rod,
40 square rods	= 1 rood,
4 roods	= 1 acre.

POWER, FUEL, ETC.

A Horse Power (H.P.) = 33,000 lbs. raised 1 ft. per minute.

To find the H.P. of a steam engine, multiply together the area of piston in sq. in., the mean pressure of steam in lbs. per sq. in., the length of stroke in feet, and the number of strokes per minute., divide the product by 33,000.

1 ton of coal = 1½ cords of dry hardwood.

1 ton of coal = 2 cords of dry softwood.

Compound engines use from 1¾ to 3 lbs. of coal per H.P. per hour; Expansive condensing engines, 4 to 7 lbs.

ENGLISH MONEY
Standard: Gold

4 farthings	= 1 penny, d.
12 pence	= 1 shilling, s.
20 shillings	= 1 pound.
21 shillings	= 1 guinea.

LONG MEASURE

12 inches, in.	= 1 foot, ft.
3 feet	= 1 yard, yd.
5½ yards	= 1 rod, pole or perch.
40 rods	= 1 furlong,
8 furlongs	= 1 statute mile,
3 miles	= 1 league.

SURVEYORS' LONG MEASURE

7 92-100 inches	= 1 link, l.
25 links	= 1 rod,
4 rods or 66 ft.	= 1 chain, ch.
80 chains	= 1 mile.

SURVEYOR'S SQUARE MEASURE

625 square links	=1 pole,
16 poles	=1 sq. chain,
10 sq. chains	=1 acre,
640 acres	=1 square mile,
36 sq. miles.	=1 township.

CUBIC MEASURE

1728 cubic inches	=1 cubic foot,
27 cubic feet	=1 cubic yard,
40 cubic feet	=1 ton ship's cargo,
216 cubic feet	=8 c.y.=1 toise (Toronto)
261½ cubic feet	=9.685 c.y.=1 toise (Montreal)

4 ft. x 4 ft. x 8 ft.=128 c. ft.=1 cord of wood.

LONG TON WEIGHT

When specified, used for coal, iron ore, etc.

14 pounds	=1 stone,
28 pounds	=1 quarter,
2 quarters	=1 cwt. or 112 lbs.
20 cwt.	=1 ton or 2,240 lbs.

BRITISH OR IMPERIAL MEASURE

Imperial gallon, Great Britain and Canada ⅓ 277.274 cub. in. or 10 lbs.

Avoirdupois distilled water at 62° F. barometer 30 in.

Wine of U.S. gallon, 231 cub. in.=8⅓ lbs. avoirdupois.

6.2321 Imperial gallons= 1 c. ft. } 62¼ lbs.
7.48052 U.S. gallons=1 cu. ft. } of water

The Winchester (U.S.) bushel=1.24445 cubic feet; the Imperial bushel = 1.2837 cub. ft.

To reduce U.S. dry measure to British, divide by 1.032.

TABLE FOR CONVERSION FROM BRITISH TO METRIC MEASURES

1 inch=25.399 millimetres,
1 cub. in.=16.386 cub. centimetres,
1 metre=3.2809 feet.
1 cub. metre=35.316 cub. ft.
1 pint=.56755 litres.
1 litre=.22024 gallons.
1 grain=.064799 grammes.
1 kilogramme=2.6792 pounds.

Interior of Brown Bros., Limited, Wholesale Stationery Warehouse, Toronto.
Mr. Beaumont Jarvis, Architect. "Steelcrete" Reinforcement and Fireproofing.

"STEELCRETE" EXPANDED METAL LATH

THE PLASTERERS' FRIEND

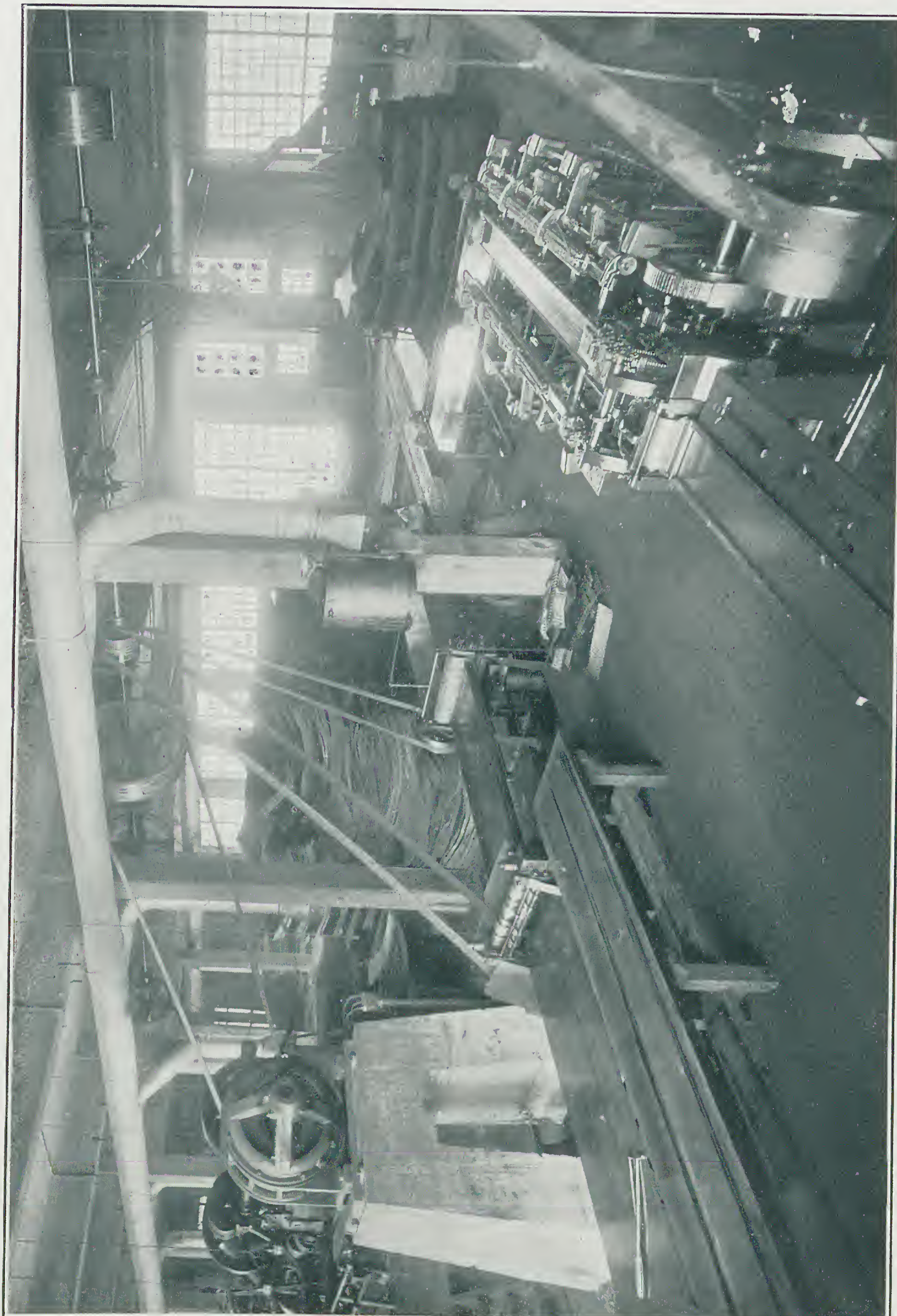
THE STANDARD ARTICLE BY WHICH ALL OTHERS HAVE BEEN AND ARE JUDGED

To have been FIRST means EXPERIENCE
(THE GREAT TEACHER)

To Remain FIRST means TRUE MERIT

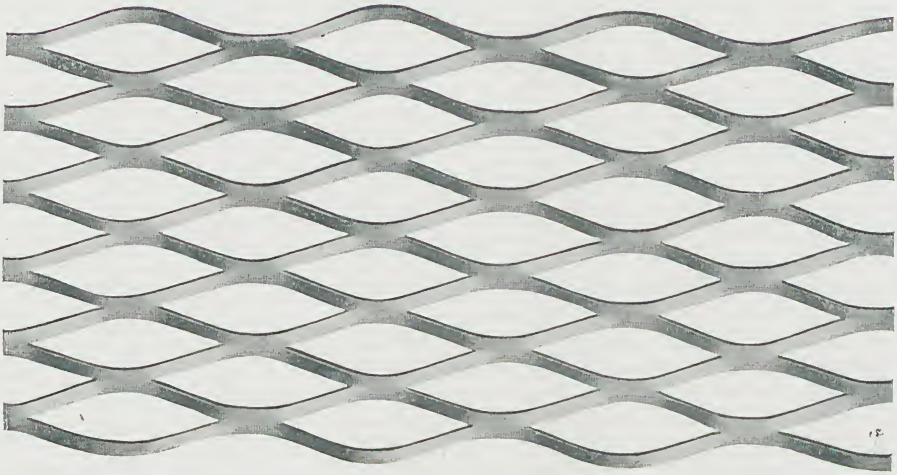
"STEELCRETE" EXPANDED METAL LATH

Is not an experiment nor a fad. It is a standard which has justly earned, through many years of test and trial, the high position it still retains in the estimation of the Architect and the Plasterer.



A Battery of "Steelcrete" Lath Machines on which the Rigid, Flat, Uniform Sheets are Cut and Expanded.

"STEELCRETE" EXPANDED METAL LATH



Made from 23, 24 and 26 gauge sheets. All 96″ x 27″, containing 2 sq. yds. per sheet. 10 sheets per bundle or 20 yds.

23 gauge weighs, per square yard	3.6 lbs.
24 " " " " "	3.2 "
26 " " " " "	2.2 "

Put them on the scales or put them on the job and compare them with competitors. Learn why "Steelcrete" Lath is more rigid and holds more plaster and therefore makes a better wall and ceiling than any other. The plasterer will cover more **yards** and waste less material. That is the reason most "Big" plasterers and architects use "Steelcrete." They have experimented and know.

"STEELCRETE" EXPANDED METAL LATH

It is easy to understand that in a cheap, built-for-quick-sale type of building, every cent of first cost counts, and wood lath is specified, but with architects and owners who are endeavoring to erect a structure which will wear and give lasting revenue, this consideration surely does not count. The difference between the cost of plaster finishes on wood lath and on "Steelcrete" Expanded Metal Lath is very small, certainly not sufficient to warrant the use of wood lath on the ground of economy. Any one with the slightest experience knows that there is no comparison in the utility or durability of the two articles.

Economy there is none in using wood lath. The first time ceilings or walls have to be repaired or redecorated on account of staining, cracking or falling plaster, the initial saving is entirely wiped out. That's the first time. How about the second, third or fourth? If architects and owners would stop to consider these points, what would be the result? **The universal use of "Steelcrete" Expanded Metal Lath. Plastered surfaces of all kinds would be more durable, handsome, fireproof and satisfactory in every way.**

We know that every architect fully appreciates the truth of these statements. The fault generally lies with short-sighted clients. For those of our friends in the profession who find themselves "up against" this difficulty, we would suggest that the thin edge of the wedge be inserted in the following places:

Lath all interior angles between walls and ceilings, etc., with a strip of "Steelcrete" Expanded Metal Lath, extending about 12 or 13 inches each way. This will greatly assist in arresting cracks, which are bound to occur on wood lath. Also place "Steelcrete" Plaster Corner Bead on all exterior angles of walls. This will protect corners from knocks and bumps and also prevent cracks.

Build smoke flues of **"Steelcrete"** Expanded Metal Lath and cement plaster.

Use **"Steelcrete"** Expanded Metal Lath for all exterior plastering.

Form mock beams for cornices, etc., with **"Steelcrete"** Expanded Metal Lath.

"Steelcrete" Expanded Lath offers superior advantages (endorsed by Canadian Fire Underwriters) for the following uses. The reduced rate pays for additional cost in a few months:—

Beam and column covering.
Fireproofing of eaves, cornices, lintels, bessemers.
Lath work around flue openings.
Ceilings over furnace rooms, boiler rooms, etc.
Fireproof stairway, elevator, and dumb waiter enclosures.

ABOUT METAL LATH

Metal lath is generally specified by gauge in catalogues. The gauge number is that of the B. W. gauge of the sheets used, before the lath is cut. The cutting and expanding process may so alter the material that it is practically impossible to discover the gauge with micrometers, so that it

is easily possible for an unscrupulous manufacturer or dealer to pass off a lighter gauge.

To guard against this, all purchasers of lath should specify the gauge and weight. The weight per square yard of "Steelcrete" Expanded Metal Lath in different gauges is given on page 105. The weights there given are guaranteed with a two and one-half per centum allowable variation, the variation with which the sheets of steel are purchased from the mills.

Painting adds but little weight to the lath.

Galvanizing adds from 0.75 lb. to 0.9 lb. per square yard, according to the gauge of the lath.

(*Be sure and specify the gauge of the metal from which the lath is cut, and in addition thereto, the weight per square yard, and if coated or galvanized, add the weight of the protection.*)

"STEELCRETE" EXPANDED METAL LATH

"Steelcrete" Expanded Metal Lath gives an absolute guarantee of the only end desirable in the use of lathing, viz., to clinch and hold the mortar. This is its only purpose, and any lath which does not insure these results is a failure. It is impossible to plaster "Steelcrete" Expanded Metal without securing a perfect key with sufficient mortar on the reverse side to make this a certainty. It is the mortar which makes the wall, not the lath. The argument used by manufacturers of some metal lathing is that their material saves mortar, which is a condemnation at once.

The lath which will use the mortar, not **waste** it, is the best lath. The closeness of the diamond mesh and the abundance of key, makes Expanded Metal partitions more adaptable to the nailing of base boards, door and window trim and picture moulding, without harm to any portion of the work.

Rigidity of lath is, of course, a matter of considerable importance, particularly during the operation of lathing and first coating. **It is on this point that "Steelcrete" Expanded Metal Mesh Lath has made and retained the friendship of the plastering trade.**

Owners, therefore, are particularly interested to see that the specifications for their buildings call for "Steelcrete" Expanded Metal Lath, that they may secure the most efficient result in construction. The fact that "Steelcrete" Expanded Metal Lath has been the standard in Canadian specifications for years is a guarantee of the correctness of the statements herein made.

OUR RUST PROOF PREPARATIONS

Private Process Dip

"Steelcrete" Expanded Metal Lath, unless otherwise called for, is always coated with our specially prepared private process dip, its most valuable asset being firm natural adherence to both steel and motar, thus rendering the whole homogeneous. This dip gives a thin but perfect coat, absolutely impervious to rust.

GALVANIZING

With certain forms of patent plaster extensively used, it is considered necessary to protect metal lath by galvanizing. After years of experimenting and actual time tests, under the most trying moisture and heat con-

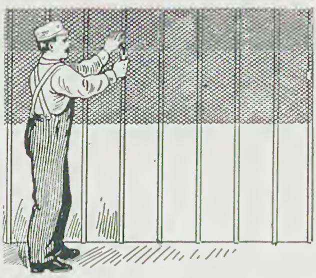
GALVANIZING—*Continued*

ditions found in buildings, we find that the most effective process is hot-dip galvanizing, such to be done only after the lath is cut and expanded. Thin electro-plating and other "make shifts" have been and are widely resorted to. All dangerous experiments. The chances are too greatly against the metal receiving a proper coating, either by accident or design. With hot-dip galvanizing it is impossible to "beat" the operation. When the metal goes in the pot, it must receive a heavy coat of non-corrosive spelter. Unless the architect realizes this difference and is prepared to specify and insist on hot-dip galvanized metal lath, which necessarily costs about 50% more than imitation galvanizing, he is more than likely to defeat the very end he is endeavoring to gain. This is to protect the metal from injurious gases and acids generated in some types of "patent" plaster. One sheet of badly galvanized lath may cause a large amount of after expense. It is wisest to take no chances. Hot dip galvanizing is no patented process. It costs more money than imitations, but it's worth more. The practice of cutting expanded lath from galvanized sheets and calling the product galvanized lath, is too ridiculous to need much comment. Of course all edges are left raw and the chances are greatly in favor of the most of the protection being "peeled" off the surface of the strands by the expanding process. Most architects agree that rather than these cheap, makeshift methods it is better to resort to a good coat of paint.

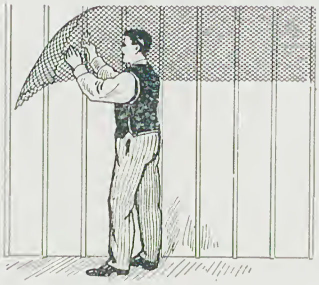
CARRIED IN STOCK

Both Process Dipped and Hot Dip Galvanized "Steelcrete" Expanded Metal Lath

"Steelcrete" Diamond Mesh Expanded Metal Lath at the same price as other laths is 15% cheaper, because of size of sheets. More square yards placed in a given time. Large sheets save waste in laps. Sheets have straight finished edges. Each sheet is a perfect rectangle. The lap is rectangular. No wasteful triangular laps. The lather likes it, the plasterer likes it, the architect likes it. The owner has value and perfect results. When he gets his building he is pleased and stays pleased.



This man covers 2 square yards of wall when he puts up a sheet of "Steelcrete" Lath.



This man covers only 1⅓ square yards of wall or less when he puts up a sheet of other Laths and it takes longer to do so.

SPECIFICATIONS FOR LATH AND PLASTER

Ceilings. Ceilings should be furred with small angles or channels not over 12 inches on centres and lathed with "Steelcrete" Expanded Metal Lath, securely wired or clamped to the supporting angles or channels. These supporting members should be firmly clamped to the bottom flanges of the steel beams if the ceiling comes directly under steel beams supporting the floor or roof above. If concrete beams are used, furring clips or hangers should be set in place on the centring and concreted into the beams. If the ceiling is to be suspended below the floor or roof above, it should first be furred with 1 inch or 1½ inch angle or channel purlins not over 3 feet or 4 feet on centres, supported by hangers securely clamped to the beam above or hung from rods or bars and concreted into the beams or slabs of the floor or roof above and spaced not more than 4 feet or 5 feet apart. Supports for ceilings to carry the weight of the ceiling only, should be designed for from 10 to 12 lbs. per square foot, while if workmen are to have access to the space above the ceiling, they should be designed for from 25 to 40 lbs. per square foot. It is sometimes convenient to frame for ceilings with small structural beams or channels 4 or 5 feet on centres framed into the bottom chords of the roof trusses.

Partitions. Partition studs should be set from 12 to 16 inches on centres and firmly secured top and bottom; the lathing should be "Steelcrete" Expanded Metal No. 24 gauge, if applied on one side of the studs only, for a solid plaster partition; the "Steelcrete" Expanded Metal No. 26 gauge may be used if the studs at 12 inch centres are to be lathed on both sides.

The lath should be securely wired or clamped to the studs every 6¾ inches and sheets should be lapped ½ inch on their long sides and 2 inches on their ends. Expanded Metal Solid partitions may be plastered with cement mortar, patent hard plaster, wood pulp or asbestos plasters; while hollow partitions may be plastered with lime mortar as well as with the plasters specified above.

Outside Wall Furring. Outside walls should be furred with small angles or channels 12 inches on centres and lathed with "Steelcrete" Expanded Metal Lath. If the wall is at all rough, it is best to first fur the walls with horizontal angles or channels 3 or 4 feet apart vertically, to line the wall and give a true, plumb surface to receive the vertical furrings, which should be attached to them by wiring or bolting.

Outside Walls. Outside walls may be lathed with "Steelcrete" No. 24 gauge Expanded Metal Lath directly on the outside boarding, the corrugated strands being sufficient to give a thorough clinch to the mortar. Some architects prefer to omit the outside boarding and staple the "Steelcrete" lath directly to the outside faces of the studs, and after the scratch coat of plaster is applied from the outside, to put on a heavy backing-up coat on the inside of the lath between the studding, to entirely encase the lath in cement and give a clinch for the mortar on the studs which will give a diagonal bracing and stiffening to the walls more than equivalent to the outside boarding which was omitted. In this case, it is necessary only to put trusses over openings in the usual manner and diagonal braces at the corners of the house to keep the frame in shape before plastering, and the solid cement wall will more than supply the rest of the stiffening necessary,

SPECIFICATIONS FOR LATH AND PLASTER—*Continued*

at the same time making a building more weathertight than any form of outside wall except masonry construction. The omission of the boarding removes the danger of cracks in the plaster due to shrinkage of the boards, and a further precaution against cracking is to fur the lath from the studs with small iron rods or flat bars on edge, over which the lath may be stapled or to which it may be wired. In case outside boarding is used, the lath should be furred off with wood strips or round or flat bars, but even then it is necessary to thoroughly work the mortar through the meshes of the lath so as to entirely enclose all of the metal. Outside walls should be plastered with best Portland cement mortar, using clean sand, and the scratch coat should contain sufficient hair to give a good clinch on the lathing, while the finish coat should be a rich mixture of cement and sand, in order to present a hard, durable surface to the weather. If the wall is to be half-timbered, the best method of half-timbering is to project an inch more or less from the face of the plaster and put on grounds with which the plaster will finish flush and then nail boards of the thickness desired to the grounds, lapping over the plaster a half-inch on each side of the grounds, and it is better to have the boards rebated on the back to prevent warping; this method prevents shrinkage cracks showing up between the half-timbering strips. If the half-timbering is flush with and projects only slightly from the plaster, the edges of the boards should be beveled so that the exposed face is wider than the back.

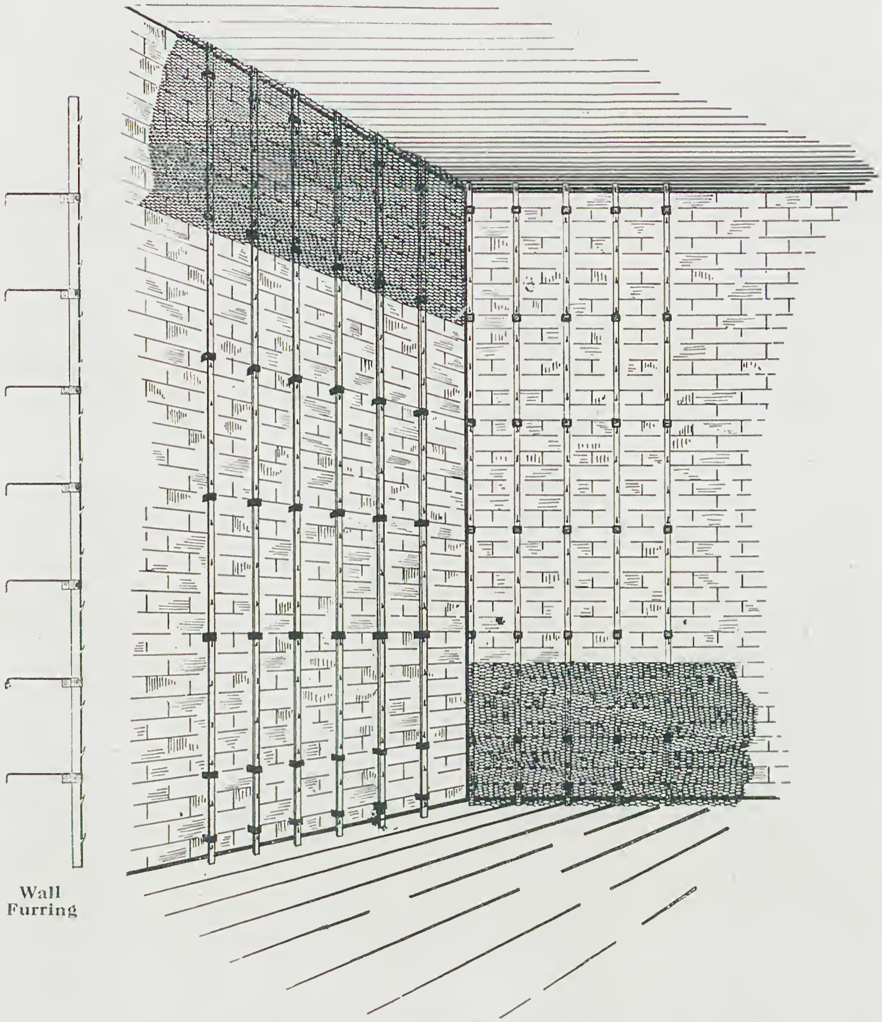
"STEELCRETE" EXPANDED METAL LATH ON WOOD CONSTRUCTION

"Steelcrete" Expanded Metal Lath may be stapled or nailed to wood joists, or studding, which should not be placed wider than 12 inches at centres, for best work. "Steelcrete" Diamond should always be placed so that the longer way of the mesh is at right angles to the joists or studding.

For ceiling work, sheets are so placed that the strands will incline upwards and away from the plasterer; on wall or partition work, the strands should incline inward and downward.

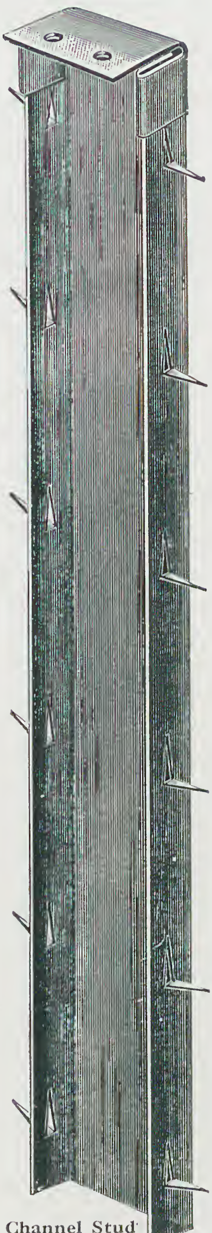
Fireproof Ceiling for Boiler Rooms, etc. In most of our cities the fire by-laws compel all boiler rooms and other places particularly liable to fire risks, to be fireproofed. Fire Insurance Underwriters also fully recognize the value of these precautions and allow a substantial reduction in rates. But whether civic by-laws or underwriters' regulations compel this or not, it certainly behooves architects and owners to protect themselves by fireproof ceilings and walls around such risks. The most simple and satisfactory fireproof ceilings on wood joists, are obtained by stapling "Steelcrete" Expanded Metal Lath to the joists, at the same time fastening tie-wires of No. 10 gauge about 10 inches long at about 18 inch centres, to the joists. This lath is then plastered in the usual way and plaster is allowed to set. Then, to the protruding tie-wires, 2 inch "Steelcrete" Channel Furring at 12 inch centres is secured, and on this Furring another layer of "Steelcrete" Expanded Metal Lath is fastened, to be in its turn plastered and finished, thus leaving a 2 inch air space between the two plaster layers—a most efficient fire-stop.

"STEELCRETE" WALL FURRING AND "CANADA FASTENERS"

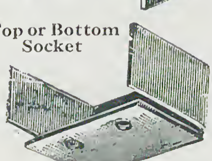


Canada Furring Fasteners Set in Position along Walls

The Canada Furring Fastener, which is adapted to exterior walls, fastens a single stud, formed of a U bar of steel with projecting tongues, to brick walls by clips, the latter being imbedded in the masonry or brickwork, as may be seen by the cut on this page. These clips are built in place by the bricklayer. Afterwards the furring bars are set up and the projecting ends of the clips in the wall are bent around the stud, leaving an air space of ¾ inch between the wall and the **Expanded Metal Lath,** the latter being attached by clinching the tongues on the stud through the meshes of the lath.



Channel Stud



Top or Bottom Socket

"STEELCRETE" STUDDING

2 inch or 3 inch Channel studding for hollow partitions as illustrated in Figure No. 34, page 114. Formed of 18 gauge steel with lath prongs punched on each side at 6¾ inch centres, for the rapid placing of "Steelcrete "Lath.

Set by means of sockets in wood construction and by 18 gauge channel rails in concrete or terra cotta floors and ceilings.

Made in 3, 4, 5, 6, 8 and 10 ft. lengths and painted with a good heavy coat of linseed oil and lead paint.

Weights—2 inch, .67 lbs. per lin. ft.
3 inch, .85 lbs. per lin. ft.

Coupling for Channel:

Couplings made of 18 gauge steel, make a splice as strong as the solid piece for lengths over 10 feet.

"STEELCRETE" T STUDDING

1" T formed of No. 18 gauge Steel

With lath prongs punched at 6¾ inch centres for the rapid placing of "Steelcrete" lath.

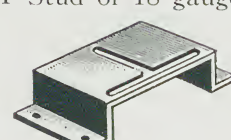
Designed for 2 inch solid cement plaster partitions or walls, as illustrated in Figure No. 25, page 115.

Much better and more convenient than the old style method of lacing lath to wrought iron channels or angles.

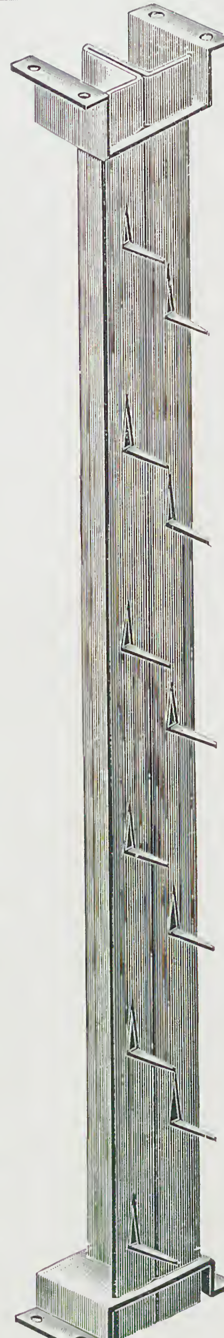
Made in 3, 4, 5, 6, 8 and 10 ft. lengths and painted with a good heavy coat of linseed oil and lead paint.

Couplings for T Stud of 18 gauge steel make strong, stiff studs over 10 feet in length.

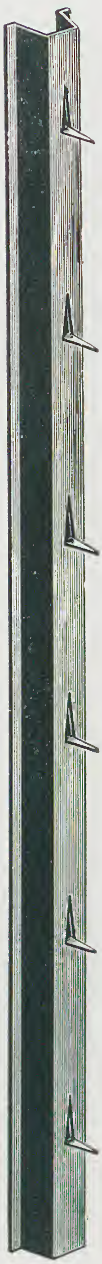
Weight—.46 lbs. per lin. ft.



Bottom Socket



T Stud



"STEELCRETE" FURRING

¾ inch U Furring formed of 18 gauge steel for outside or inside walls, partitions or ceilings. The prongs punched at 6¾ inch centres make the application of "Steelcrete" Metal Lath very easy and rapid. The prongs are heavy and sound and will hold lath securely.

Made in 3, 4, 5, 6, 8 and 10 ft. lengths and painted.

Weight—.05 lbs. per lin. ft.

"Steelcrete" Angle Studding, 1″

1 inch Angle Studding formed of 18 gauge steel for use with both "Steelcrete" T or Channel studding.

PARTITION AND WALL CONSTRUCTION

Partition and wall construction of Expanded Metal and mortar is of two general types, viz., Hollow and solid partitions.

Figure No. 34 illustrates type of hollow partition. Its many advantages over any other fireproof partitions are self-evident, but among the chief of them may be mentioned:

1. It is very light, strong and economical.
2. Plumbing, steam, gas and electric pipes may be concealed inside without danger from expansion in case of fire and may be run either horizontally or vertically.
3. As we punch the studs for grounds wherever desired, it is a very simple matter to provide nailings for wood finish.
4. It may be used for bearing partitions, if desired.
5. It can be made any thickness, from 3 inches up, with very slight increase in cost.
6. It is as near sound-proof as any partition can be made.
7. It can be plastered with common mortar as the studs are stiff enough to require no further stiffening, although cement plaster or any of the patent hard mortars may be used, if desired.
8. As shown in detail, the ordinary method of framing around doors is used, thereby avoiding the use of specially designed frames.

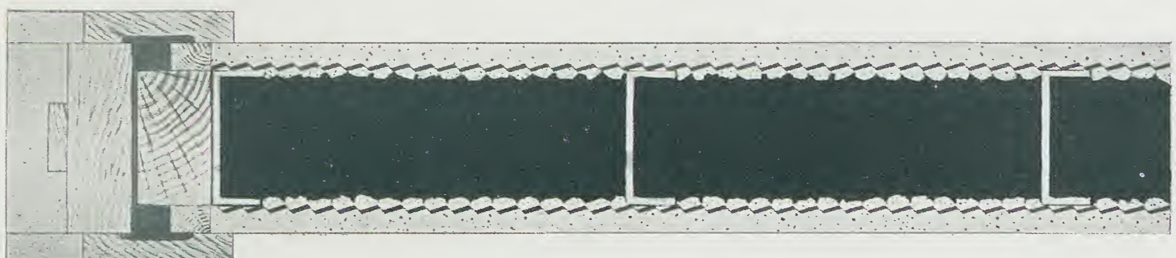


Fig. No. 34

SOLID PARTITIONS

Figures No. 24 and 25 show methods of building Channel and T Iron and "Steelcrete" Expanded Metal solid partitions. Suggestions for wood frames for doors are shown in Figure 25 and a very satisfactory detail for an iron frame for a tinned door is shown in Figure 24. It is necessary to use a hard plaster or Portland Cement mortar to make first-class construction. The partitions are practically sound proof, are light and do not require special framing to carry them, take up very little room and are not expensive. They have been used with success in every class of building.

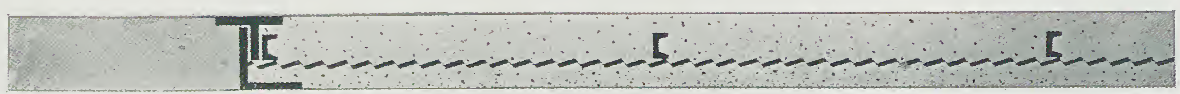


Fig. No. 24

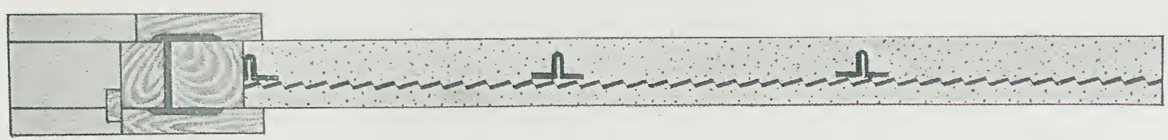


Fig. No. 25

OUTSIDE WALL CONSTRUCTION

Figure No. 34 shows a method of building an outside wall of cement plaster on Expanded Metal lath and iron studs. This construction stands the weather well, and is warm in winter and cool in summer. Figures 35 and 36 illustrate two methods of building this outside wall on wood studding. When the wall is built as shown in Figures 34 and 35, the plaster on the outside face of the stud is backed up before the lathing is attached to the inside face of the stud, thus entirely enclosing the outside lathing in cement mortar and perfectly protecting it from corrosion. The two sources of cracks in this construction are unequal settlement of the foundation and shrinkage of the wood frame. If the footings are carefully designed and the detail shown in Figure 34 used, both of these dangers are avoided. The detail shown in Figure 35 would be less liable to shrinkage cracks than that shown in Figure 36, which would be subject to the shrinkage of the outside boarding, although this is practically overcome by stapling one-quarter-inch rods to the boarding and securing the lath to them.

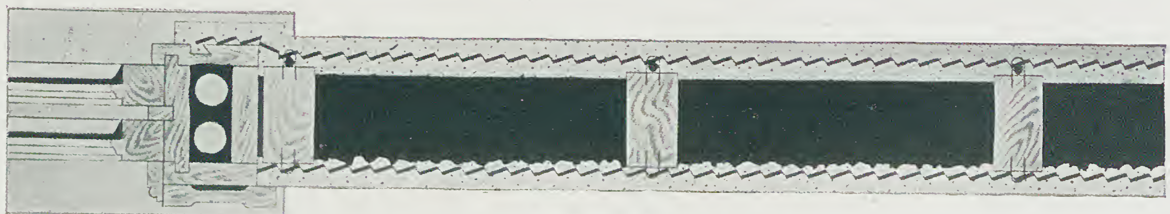


Fig. No. 35

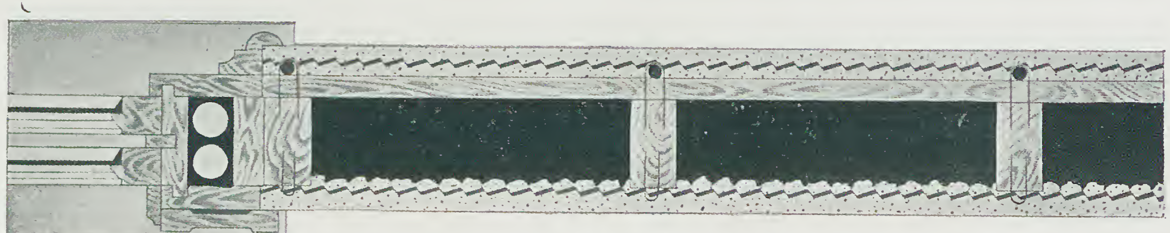


Fig. No. 36

CEMENT STUCCO FOR EXTERIORS

Cement exteriors are becoming the fashion. They present a much handsomer appearance than any other material, do not require painting, and are extremely durable when the plaster is put over metal lath. Wood lath is too much affected by atmospheric changes, and cracks in the wall result. With metal lath a stucco exterior reduces the insurance rate.

The first coat should be thin and be a cement-lime mortar. A cement mortar with no lime is better. The second coat (and third, if there is a third coat) should contain no lime, but should be a Portland Cement mortar.

When the first coat has set hard enough to carry the weight of the second coat, the surface should be thoroughly wet and the second coat applied with a wooden float. This coat should be about one quarter of an inch thick.

Cementine House Design

Expanded Metal Lath used for exterior work should always be painted or galvanized.

For satisfactory work, the outside walls should be protected for at least two weeks by canvas or burlap curtains saturated with water. When too much cement is used, fine hair cracks will appear. Cracks will also appear when the plaster is applied without sufficient moisture, when troweled too much, when not troweled enough, when not protected from changes in temperature until thoroughly set. Notwithstanding this it is simple work, and a good plasterer soon obtains excellent results. When Expanded Metal Lath with the small mesh is used, it is extremely rare that cracks appear, for Metal Lath reinforces the plaster and prevents cracks. Cement exteriors have become popular since the introduction of small mesh Steelcrete Expanded Metal Lath.

FINISH OF WALLS

The final coat is frequently colored. The following table for use of coloring materials is from the 1904 Annual Report of the Ohio State Geologist. The slight differences in recipes are due to the fact that three authorities are given.

MATERIALS USED IN COLORING MORTARS

Color	Mineral	Pounds of Color to 100 pounds of Cement		Pounds Color to bbl. of Cement
		1	2	3
Gray.....	Germantown Lamp Black.........	1-4	1-2	2
Black.....	Manganese Dioxide...............	12	00	48
Black.....	Excelsior Carbon Black............	00	2	00
Blue......	Ultramarine......................	5	5 to 6	20
Green.....	Ultramarine Green...............	6	6	24
Red......	Iron Oxide......................	6	6 to 10	24
Bright Red	Pompein or English Red..........	6	6	24
Sandstone.	Red-Purple Oxide of Iron.........	6	00	24
Violet.....	Violet Oxide of Iron...............	6	00	24
Brown....	Roasted Iron Oxide or Brown Ochre	6	6	24
Yellow or Buff...	Yellow Ochre....................	6	6 to 10	24

PEBBLE-DASH FINISH

When first coat is thoroughly dry, mix two parts of cement (stainless preferred) with one part lime flour, to the consistency of thick cream, and add clean washed pebbles until it resembles a pudding. With a wood paddle about six inches wide, dash this mixture on to the wall. After the wall is covered, it is a good plan to go over it with a whitewash brush dipped in the mixture, to obtain a uniform color and appearance.

FLOAT FINISH

Float the last coat, which has no hair or fibre in it, sufficiently to bring the strand to the surface. Use a wood float for sand finish.

ROUGH CAST FINISH

The rough cast coat is mixed as for the Pebble Dash without the pebbles, and applied in the same manner. Sometimes the rough cast coat is simply a cement mortar coat without lime paste and is thrown on with a wood paddle, but it takes an expert to do good work in this manner. No. 10 or No. 25 crushed stone or fine cinders may be used in place of pebbles and applied in the same manner.

Cementine Residence

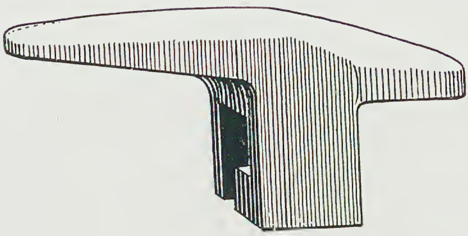
AREA COVERED BY MORTAR

Produced from one barrel of Portland Cement Mortar (3.8 cu. ft. Cement Paste) No lime:

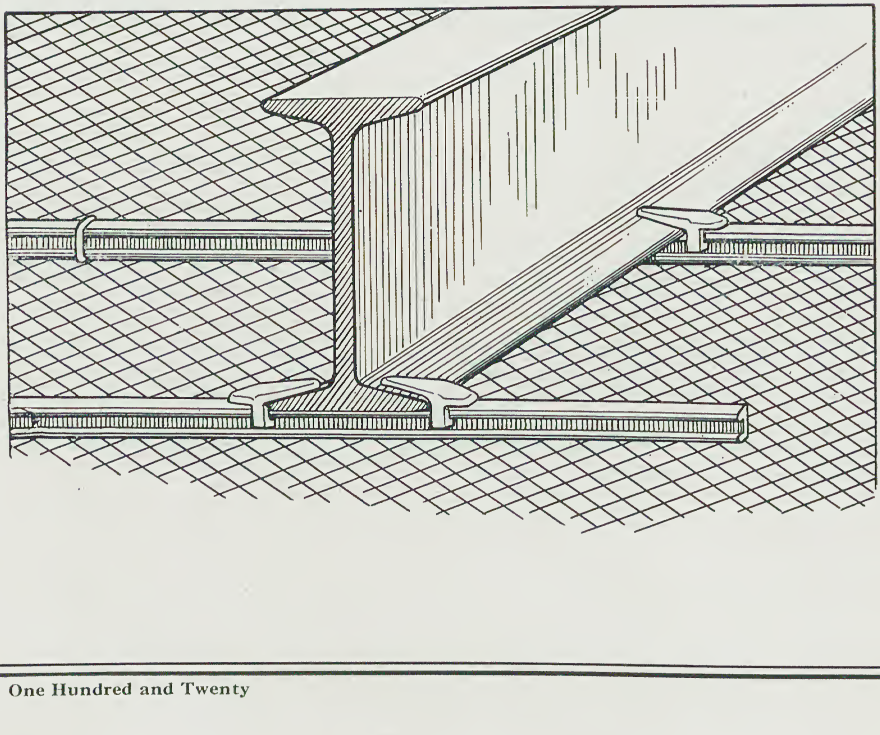
Composition of Mortar	Thickness of Coat	Square Feet of Area Covered
1 Cement, 1 Sand	1 inch ¾ " ½ "	67 90 134
1 Cement, 2 Sand	1 inch ¾ " ½ "	104 139 208
1 Cement, 3 Sand	1 inch ¾ " ½ "	140 187 280

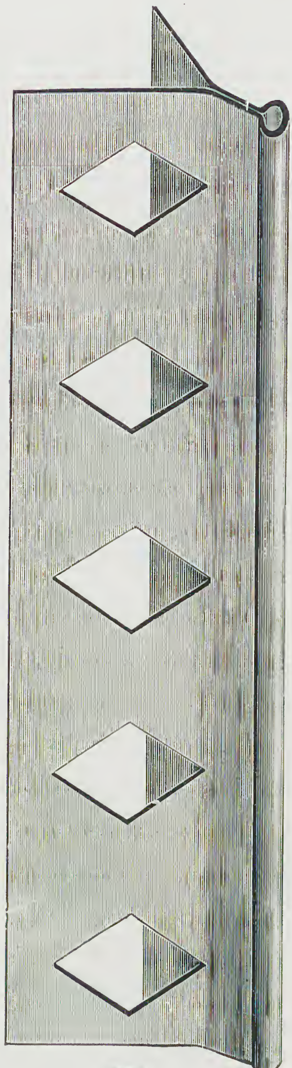
"STEELCRETE" CHANNEL CLIPS

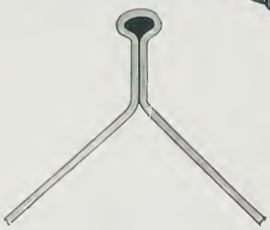
Malleable Iron Clips for Quickly and Securely Fastening Channel Furring to Steel I Beams.



Actual Size







Actual Size

"STEELCRETE" PLASTERERS' CORNER BEAD

Formed of Galvanized Sheet Steel

Essential on every outside plastered corner in every good building.

Insures perfectly straight, true, unbroken plaster corners.

For use with either Metal or Wood lath.

Diamond Holes afford a perfect key for plaster.

Deep, straight neck provides for sufficient plaster to overcome cracking or chipping at corner.

Made in 5, 6, 8 and 10 ft. lengths, and packed in crates containing 1,000 lin. feet.

Weight—200 lbs. per 1,000 lin. feet.

SUSPENDED CEILINGS

THIS style of construction lends itself readily in connection with structured steel frames, reinforced concrete or tile construction, where there are beams showing below the floor slab and where it is desirable to make the ceiling flush.

Such a suspended ceiling allows for all pipes, conduits and wiring to be hidden. In case of reinforced concrete or tiled floors, and where the steel beams are not exposed, hangers should be built in. We illustrate herewith some methods of arranging hangers, carrying-bars and furring.

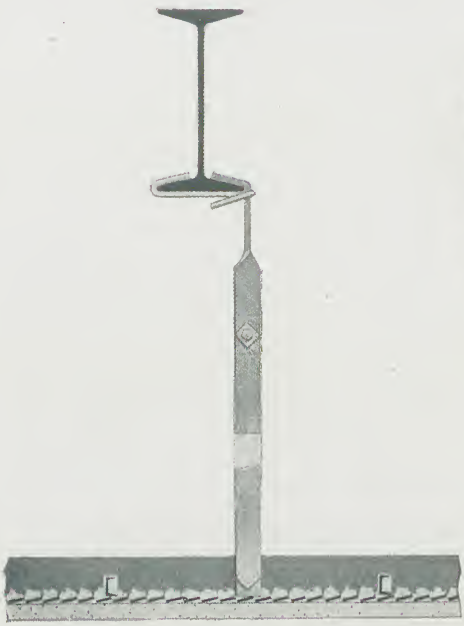


Fig. 40

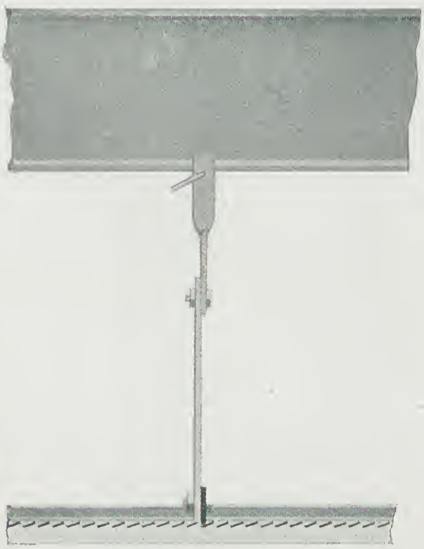
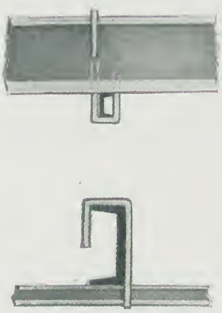
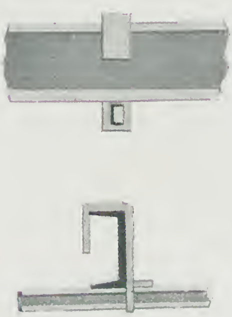


Fig. 41





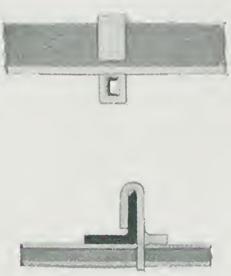


Fig. 44

Fig. 45

Fig. 46

SUSPENDED CEILINGS—*Continued*

Figures 40 to 46 show details for suspended ceilings.

Figures 40 and 41 are cross sections in both directions showing one-piece hangers from the beams and carrying-bars of flat iron, punched with suitable holes to take the channel furring for the lath.

Fig. 42

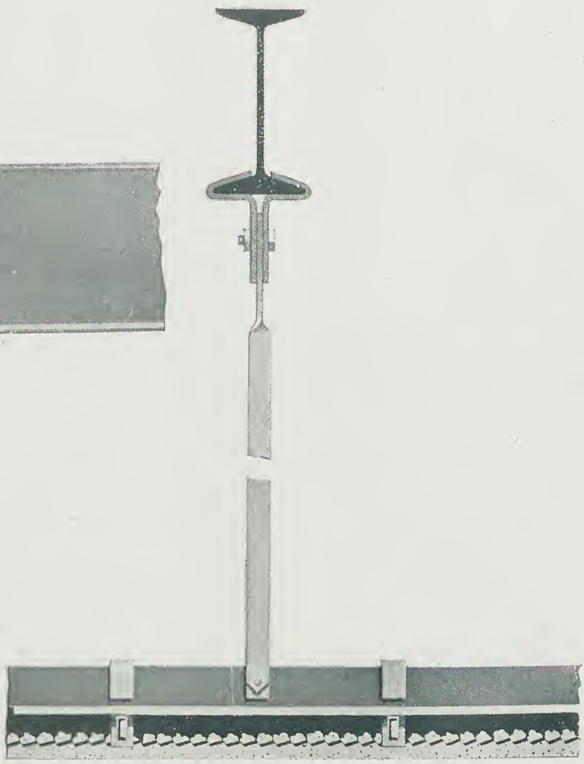


Fig. 43

Figures 42 and 43 show cross sections of a two-piece hanger. The angle iron carrying-bars are bolted to the hangers and the channel iron secured to the angles with the furring clip shown in Figure 46.

Figures 44 and 45 illustrate two varieties of furring clip for securing the furring channels to the carrying-bars, where channel section is employed in lieu of angle section.

COLUMN FIREPROOFING

Figures Nos. 49 to 52 show typical methods of fireproofing columns. These details are subject to modification according to the degree of thoroughness with which it is desired to have the fireproofing done, as, for instance, Figures 49 and 51 might be shown furred and filled solidly around with concrete, as in Figures Nos. 50 and 52; or Figures Nos. 50 and 52 might be shown wrapped closely with expanded metal lath and fireproofed with plaster, as in Figure 49, and the space inside the lath filled with concrete or not, as desired.

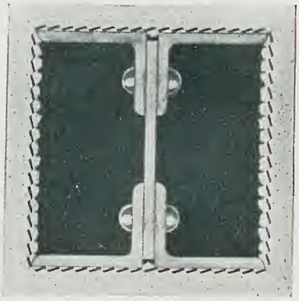


Fig. 49

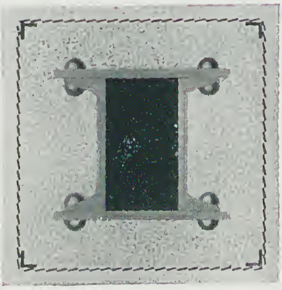


Fig. 50

Fig. 51

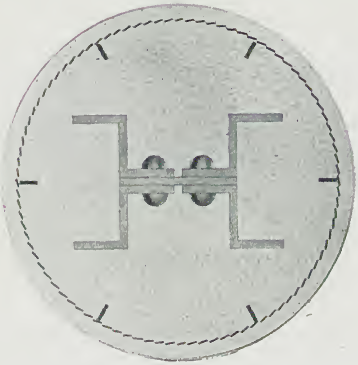


Fig. 52

ORNAMENTAL FURRING AND LATHING

Figure No. 47 illustrates typical details of the use of iron furring and expanded metal lath in ornamental plaster work. Illustrations of elaborate work of this kind are shown on page 126.

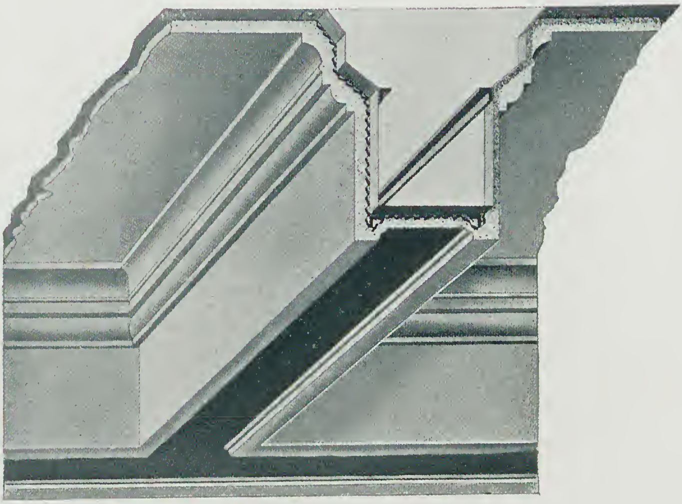
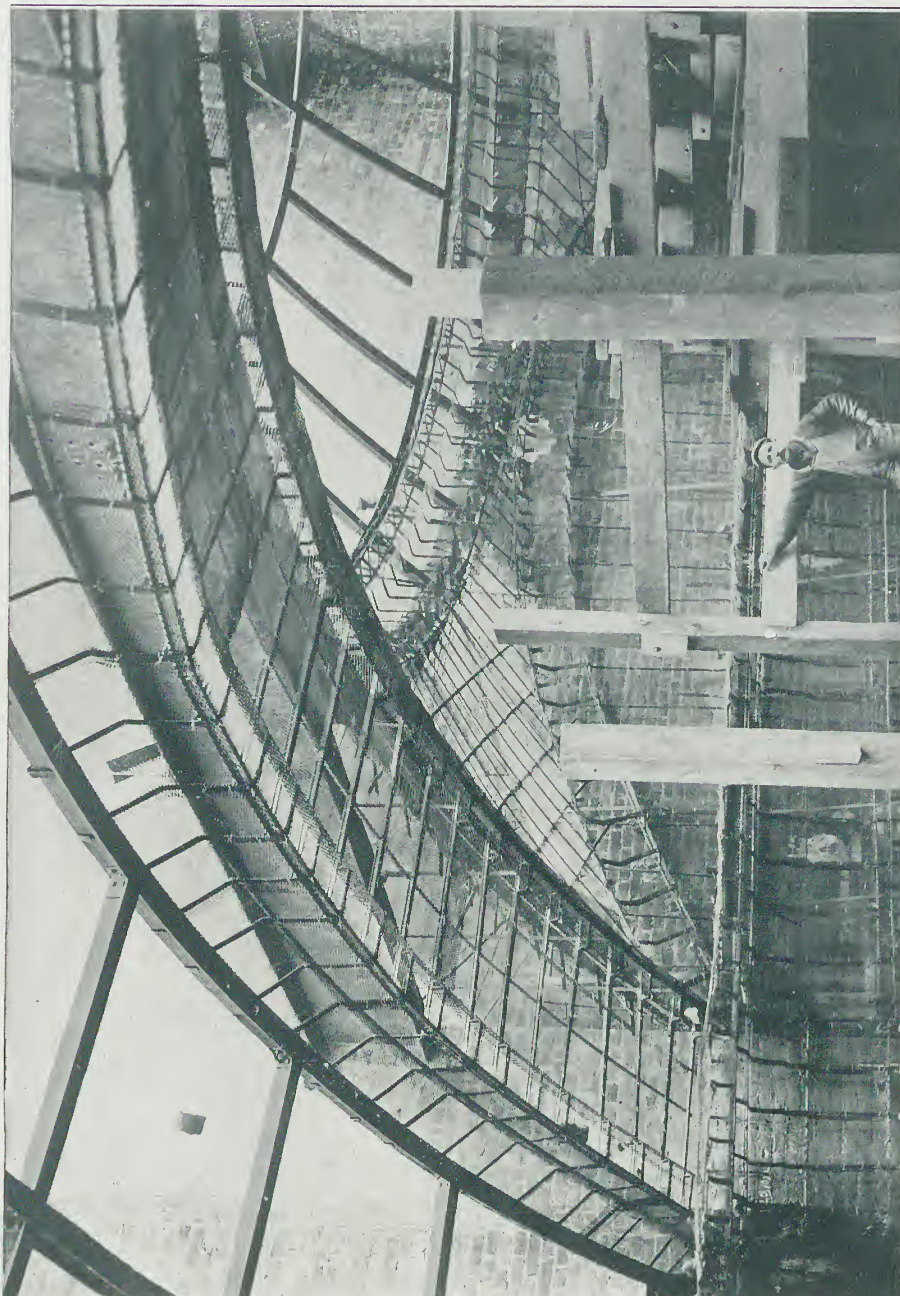


Fig. 47

ORNAMENTAL PLASTERING

The possibilities of accomplishment in the ornamental line with iron furring, Expanded Metal lathing and plastering, are without limit. As the skill of the mechanic follows the development of the artist's designs, the beauty of the art in real life is increased and multiplied. At this date one of the most artistic features of modern construction is represented by what is wrought out by the combined efforts of artists and skilled workmen. The old day of plain plastered walls and flat ceilings is succeeded by real art in steel and mortar. We show in this connection a few samples of what has been accomplished.



Dome Ceiling Work performed with "Steelcrete" products in Banking Room, Bank of Nova Scotia, Toronto.
Messrs. Darling & Pearson, Architects.

Interior Convocation Hall, University of Toronto. Messrs. Darling & Pearson, Architects.
"Steelcrete" Reinforcement, also all Plaster Finish done on "Steelcrete" Lath and Framing.

Interior Main Banking Room, Canadian Bank of Commerce Building, Montreal
Messrs. Darling and Pearson, Architects
Heavy Ornamental Plaster Work done on "Steelcrete" Lath

HANDY TABLES FOR THE PLASTERER

THESE tables, giving the number of square yards and feet in the walls and ceilings of several thousand different sizes of rooms, will, we hope, be found a time saver to the plasterer. We can vouch for the accuracy of these quantities.

USE OF TABLES

Suppose we have a room 17′ x 21′, with walls 8′ 6″ high. Turn to the table for 8′ 6″ ceilings. Go down the left hand corner to 17 and then across this line to column headed 21 and we find 111 yards 4 feet of work.

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 7-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3	10.3	12.2	14.1	16.0	17.8	19.7	21.6	23.5	25.4	27.3	29.2	31.1	33.0	34 8	36.7	38.6	40.5	42.4	44.3	46.2
4	12.2	14.2	16.2	18.2	20.2	22.2	24.2	26.2	28.2	30.2	32.2	34.2	36.2	38.2	40.2	42.2	44.2	46.2	48.2	50.2
5	14.1	16.2	18.3	20.4	22.5	24.6	26.7	28.8	31.0	33.1	35.2	37.3	39.4	41.5	43.6	45.7	47.8	50.0	52.1	54.2
6	16.0	18.2	20.4	22.6	24.8	27.1	29.3	31.5	33.7	36.0	38.2	40.4	42.6	44.8	47.1	49.3	51.5	53.7	55.8	58.2
7	17.8	20.2	22.5	24.8	27.2	29.5	31.8	34.2	36.5	38.8	41.2	43.5	45.8	48.2	50.5	52.8	55.2	57.5	59.8	62.2
8	19.7	22.2	24.6	27.1	29.5	32.0	34.4	36.8	39.3	41.7	44.2	46.6	49.1	51.5	54.0	56.4	58.8	61.3	63.7	66.2
9	21.6	24.2	26.7	29.3	31.8	34.4	37.0	39.5	42.1	44.6	47.2	49.7	52.3	54.8	57.4	60.0	62.5	65.1	67.6	70.2
10	23.5	26.2	28.8	31.5	34.2	36.8	39.5	42.2	44.8	47.5	50.2	52.8	55.5	58.2	60.8	63.5	66.2	68.8	71.5	74.2
11	25.4	28.2	31.0	33.7	36.5	39.3	42.1	44.8	47.6	50.4	53.2	56.0	58.7	61.5	64.3	67.1	69.8	72.6	75.4	78.2
12	27.3	30.2	33.1	36.0	38.8	41.7	44.6	47.5	50.4	53.3	56.2	59.1	62.0	64.8	67.7	70.6	73.5	76.4	79:3	82.2
13	29.2	32.2	35.2	38.2	41.2	44.2	47.2	50.2	53.2	56.2	59.2	62.2	65.2	68.2	71.2	74.2	77.2	80.2	83.2	86.2
14	31.1	34.2	37.3	40.4	43.5	46.6	49.7	52.8	56.0	59.1	62.2	65.3	68.4	71.5	74.6	77.7	80.8	84.0	87.1	90.2
15	33.0	36.2	39.4	42.6	45.8	49.1	52.3	55.5	58.7	62.0	65.2	68.4	71.6	74.8	78.1	81.3	84.5	87.7	91.0	94.2
16	34.8	38.2	41.5	44.8	48.2	51.5	54.8	58.2	61.5	64.8	68.2	71.5	74.8	78.2	81.5	84.8	88.2	91.5	94.8	98.2
17	36.7	40.2	43.6	47.1	50.5	54.0	57.4	60.8	64.3	67.7	71.2	74.6	78.1	81.5	85.5	88.4	91.8	95.3	98.7	102.2
18	38.6	42.2	45.7	49.3	52.8	56.4	60.0	63.5	67.1	70.6	74.2	77.7	81.3	84.8	88.4	92.0	95.5	99.1	102.6	106.2
19	40.5	44.2	47.8	51.5	55.2	58.8	62.5	66.2	69.8	73.5	77.2	80.8	84.5	88.2	91.8	95.5	99.2	102.8	106.5	110.2
20	42.4	46.2	50.0	53.7	57.5	61.3	65.1	68.8	72.6	76.4	80.2	84.0	87.7	91.5	95.3	99.1	102.8	106.6	110.4	114.0
21	44.3	48.2	52.1	55.8	59.8	63.7	67.6	71.5	75.4	79.3	83.2	87.1	91.0	94.8	98.7	102.6	106.5	110.4	114.3	118.2
22	46.2	50.2	54.2	58.2	62.2	66.2	70.2	74.2	78.2	82.2	86.2	90.2	94.2	98.2	102.2	106.2	110.2	114.2	118.2	122.2
23	48.0	52.2	56.3	60.4	64.5	68.6	72.1	76.8	81.0	85.1	89.2	93.3	97.4	101.5	105.6	109.7	113.8	118.0	122.1	126.2
24	50.0	54.2	58.4	62.6	66.8	71.1	75.3	79.5	83.7	88.0	92.2	96.4	100.6	104.8	109.1	113.3	117.5	121.7	126.0	130.2

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 7.6-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3 ...	11.0	13.0	15.0	17.0	19.0	21.0	23.0	25.0	27.0	29.0	31.0	33.0	35.0	37.0	39.0	41.0	43.0	45.0	47.0	49.0
4 ...	13.0	15.1	17.2	19.3	21.4	23.5	25.6	27.7	29.8	32.0	34.1	36.2	38.3	40.4	42.5	44.6	46.7	49.8	51.0	53.1
5 ...	15.0	17.2	19.4	21.6	23.8	26.1	28.3	30.5	32.7	35.0	37.2	39.4	41.6	43.8	46.1	48.3	50.5	52.7	55.0	57.2
6 ...	17.0	19.3	21.6	24.0	26.3	28.6	31.0	33.3	35.6	38.0	40.3	42.6	45.0	47.3	49.6	52.0	54.3	56.6	59.0	61.3
7 ...	19.0	21.4	23.8	26.3	28.7	31.2	33.6	36.1	38.5	41.0	43.4	45.8	48.3	50.7	53.2	55.6	58.1	60.5	63.0	65.4
8 ...	21.0	23.5	26.1	28.6	31.2	33.7	36.3	38.8	41.4	44.0	46.5	49.1	51.6	54.2	56.7	59.3	61.8	64.4	67.0	69.5
9 ...	23.0	25.6	28.3	31.0	33.6	36.3	39.0	41.6	44.3	47.0	49.6	52.3	55.0	57.6	60.3	63.0	65.6	68.3	71.0	73.6
10 ...	25.0	27.7	30.5	33.3	36.1	38.8	41.6	44.4	47.2	50.0	52.7	55.5	58.3	61.1	63.8	66.6	69.4	72.2	75.0	77.7
11 ...	27.0	29.8	32.7	35.6	38.5	41.4	44.3	47.2	50.1	53.0	55.8	58.7	61.6	64.5	67.4	70.3	73.2	76.1	79.0	81.8
12 ...	29.0	32.0	35.0	38.0	41.0	44.0	47.0	50.0	53.0	56.0	59.0	62.0	65.0	68.0	71.0	74.0	77.0	80.0	83.0	86.0
13 ...	31.0	34.1	37.2	40.3	43.4	46.5	49.6	52.7	55.8	59.0	62.1	65.2	68.3	71.4	74.5	77.6	80.7	84.8	87.0	90.1
14 ...	33.0	36.2	39.4	42.6	45.8	49.1	52.3	55.5	58.7	62.0	65.2	68.4	71.6	74.8	78.1	81.3	84.5	87.7	91.0	94.2
15 ...	35.0	38.3	41.6	45.0	48.3	51.6	55.0	58.3	61.6	65.0	68.3	71.6	75.0	78.3	81.6	85.0	88.3	91.6	95.0	98.3
16 ...	37.0	40.4	43.8	47.3	50.7	54.2	57.6	61.1	64.5	68.0	71.4	74.8	78.3	81.7	85.2	88.6	92.1	95.5	99.0	102.4
17 ...	39.0	42.5	46.1	49.6	53.2	56.7	60.3	63.8	67.4	71.0	74.5	78.1	81.6	85.2	88.7	92.3	95.8	99.4	103.0	106.5
18 ...	41.0	44.6	48.3	52.0	55.6	59.3	63.0	66.6	70.3	74.0	77.6	81.2	85.0	88.6	92.3	96.0	99.6	103.3	107.0	110.6
19 ...	43.0	46.7	50.5	54.3	58.1	61.8	65.6	69.4	73.2	77.0	80.7	84.5	88.3	92.1	95.8	99.6	103.4	107.2	111.0	114.7
20 ...	45.0	49.8	52.7	56.6	60.5	64.4	68.3	72.2	76.1	80.0	84.8	87.7	91.6	95.5	99.4	103.3	107.2	111.1	115.0	118.8
21 ...	47.0	51.0	55.0	59.0	63.0	67.0	71.0	75.0	79.0	83.0	87.0	91.0	95.0	99.0	103.0	107.0	111.0	115.0	119.0	123.0
22 ...	49.0	53.1	57.2	61.3	65.4	69.5	73.6	77.7	81.8	86.0	90.1	94.2	98.3	102.4	106.5	110.6	114.7	118.8	123.0	127.0
23 ...	51.0	55.2	59.4	63.6	67.8	72.1	76.3	80.5	84.7	89.0	93.2	97.4	101.6	105.8	110.1	114.3	118.5	122.7	127.0	131.2
24 ...	53.0	57.3	61.6	66.0	70.3	74.6	79.3	80.5	84.7	89.0	93.2	97.4	101.6	105.3	113.6	118.0	122.3	126.6	131.0	135.3

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 8-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3 ...	11.6	13.7	15.8	18.0	20.1	22.2	24.3	26.4	28.5	30.6	32.7	34.8	37.0	39.1	41.2	43.3	45.4	47.5	49.6	51.7
4 ...	13.7	16.0	18.2	20.4	22.6	24.8	27.1	29.3	31.5	33.7	36.0	38.2	40.4	42.6	44.8	47.1	49.3	51.5	53.7	56.0
5 ...	15.8	18.2	20.5	22.8	25.2	27.5	29.8	32.2	34.5	36.8	39.2	41.5	43.8	46.2	48.5	50.8	53.2	55.5	57.8	60.2
6 ...	18.0	20.4	22.8	25.3	27.7	30.2	32.6	35.1	37.5	40.0	42.4	44.8	47.3	49.7	52.2	54.6	57.1	59.5	62.0	64.4
7 ...	20.1	22.6	25.2	27.7	30.3	32.8	35.4	38.0	40.5	43.1	45.6	48.2	50.7	53.3	55.8	58.4	61.0	63.5	66.1	68.9
8 ...	22.2	24.8	27.5	30.2	32.8	35.5	38.2	40.8	43.5	46.2	48.8	51.5	54.2	56.8	59.5	62.2	64.8	67.5	70.2	72.8
9 ...	24.3	27.1	29.8	32.6	35.4	38.2	41.0	43.7	46.5	49.3	52.1	54.8	57.6	60.4	63.2	66.0	68.7	71.5	74.3	77.1
10 ...	26.4	29.3	32.2	35.1	38.0	40.8	43.7	46.6	49.5	52.4	55.3	58.2	61.1	64.0	66.8	69.7	72.6	75.5	78.4	81.3
11 ...	28.5	31.5	34.5	37.5	40.5	43.5	46.5	49.5	52.5	55.5	58.5	61.5	64.5	67.5	70.5	73.5	76.5	79.5	82.5	85.5
12 ...	30.6	33.7	36.8	40.0	43.1	46.2	49.3	52.4	55.5	58.6	61.7	64.8	68.0	71.1	74.2	77.3	80.4	83.5	86.6	89.7
13 ...	32.7	36.0	39.2	42.4	45.6	48.8	52.1	55.3	58.5	61.7	65.0	68.2	71.4	73.6	77.8	81.1	84.3	87.5	90.7	94.0
14 ...	34.8	38.2	41.5	44.8	48.2	51.5	54.8	58.2	61.5	64.8	68.2	71.5	74.8	78.2	81.5	84.8	88.2	91.5	94.8	98.2
15 ...	37.0	40.4	43.8	47.3	50.7	54.2	57.6	61.1	64.5	68.0	71.4	74.8	78.3	81.7	85.2	88.6	92.1	95.5	99.0	102.4
16 ...	39.1	42.6	46.2	49.7	53.3	56.8	60.4	64.0	67.5	71.1	74.6	78.2	81.7	85.3	88.8	92.4	96.0	99.5	103.1	106.6
17 ...	41.2	44.8	48.5	52.5	55.8	59.5	63.2	66.8	70.5	74.2	77.8	81.5	85.2	88.8	92.5	96.2	99.8	103.5	707.2	110.8
18 ...	43.3	47.1	50.8	54.6	58.4	62.2	66.0	69.7	73.5	77.3	81.1	84.8	88.6	92.4	96.2	100.0	103.7	107.5	111.3	115.1
19 ...	45.4	49.3	53.2	57.1	61.0	64.8	68.7	72.6	76.5	80.4	84.3	88.2	92.1	96.0	99.8	103.7	107.6	111.5	115.4	119.3
20 ...	47.5	51.5	55.5	59.5	63.5	67.5	71.5	75.5	79.5	83.5	87.5	91.5	95.5	99.5	103.5	107.5	111.5	115.4	119.5	123.5
21 ...	49.6	53.7	57.8	62.0	66.1	70.2	74.3	78.4	82.5	86.6	90.7	94.8	99.0	103.1	107.2	111.3	115.4	119.5	123.6	127.7
22 ...	51.7	56.0	60.2	64.4	68.8	72.8	77.1	81.3	85.5	89.7	94.0	98.2	102.4	106.6	110.8	115.1	119.3	123.5	127.7	132.0
23 ...	53.8	58.2	62.5	66.8	71.2	75.5	79.8	84.2	88.5	92.8	97.2	101.5	105.8	110.2	114.5	118.8	123.2	127.5	131.8	136.2
24 ...	56.0	60.4	64.8	69.3	73.7	78.2	82.6	87.1	91.5	96.0	100.4	104.8	109.3	113.7	118.2	122.6	127.1	131.5	136.0	140.4

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 8.6-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3..	12.3	14.5	16.7	19.0	21.2	23.4	25.6	27.8	30.1	32.2	34.5	36.7	39.0	41.2	43.4	45.6	47.8	50.1	52.3	54.5
4..	14.5	16.8	19.2	21.5	23.8	26.2	28.5	30.8	33.2	35.5	37.8	40.2	42.5	44.8	47.2	49.5	51.8	54.2	56.5	58.8
5..	16.7	19.2	21.6	24.1	26.5	29.0	31.4	33.8	36.3	38.7	41.2	43.6	46.1	48.5	51.0	53.4	55.8	58.3	60.7	63.2
6..	19.0	21.5	24.1	26.6	29.2	31.7	34.3	36.8	39.4	42.0	44.5	47.1	49.6	52.5	54.7	57.3	59.8	62.4	65.0	67.5
7..	21.2	23.8	26.5	29.2	31.8	34.5	37.2	39.8	42.5	45.2	47.8	50.5	53.2	55.8	58.5	61.2	63.8	66.5	69.2	71.8
8..	23.4	26.2	29.0	31.7	34.5	37.3	40.1	42.8	45.6	48.4	51.2	54.0	56.7	59.5	62.3	65.1	67.8	70.6	73.4	76.2
9..	25.6	28.5	31.4	34.3	37.2	40.1	43.0	45.8	48.7	51.6	54.5	57.4	60.3	63.2	66.1	69.0	71.8	74.7	77.6	80.5
10..	27.8	30.8	33.8	36.8	39.8	42.8	45.8	48.8	51.8	54.8	57.8	60.8	63.8	66.8	69.8	72.8	75.8	78.8	81.8	84.8
11..	30.1	33.2	36.3	39.4	42.5	45.6	48.7	51.8	55.0	58.1	61.2	64.3	67.4	70.5	73.6	76.7	79.8	83.0	86.1	89.2
12..	32.2	35.5	38.7	42.0	45.2	48.4	51.6	54.8	58.1	61.3	64.5	67.7	71.0	74.2	77.4	80.6	83.8	87.1	90.3	93.5
13..	34.5	37.8	41.2	44.5	47.8	51.2	54.5	57.8	61.2	64.5	67.8	71.2	74.5	77.8	81.2	84.5	87.8	91.2	94.5	97.8
14..	36.7	40.2	43.6	47.1	50.5	54.0	57.4	60.8	64.3	67.7	71.2	74.6	78.1	81.5	85.0	88.4	91.8	95.3	98.7	102.2
15..	39.0	42.5	46.1	49.6	53.2	56.7	60.3	63.8	67.4	71.0	74.5	78.1	81.6	85.2	88.7	92.3	95.8	99.4	103.0	106.5
16..	41.2	44.8	48.5	52.2	55.8	59.5	63.2	66.8	70.5	74.2	77.8	81.5	85.2	88.8	92.5	96.2	99.8	103.5	107.2	110.8
17..	43.4	47.2	51.0	54.7	58.5	62.3	66.1	69.8	73.6	77.4	81.2	85.0	88.7	92.5	96.3	100.1	103.8	107.6	111.4	115.2
18..	45.6	49.5	53.4	75.3	61.2	65.1	69.0	72.8	76.7	80.6	84.5	88.4	92.3	96.2	100.1	104.0	107.8	111.7	115.6	119.5
19..	47.8	51.8	55.8	59.8	63.8	67.8	71.8	75.8	79.8	83.8	87.8	91.8	95.8	99.8	103.3	107.8	111.8	115.8	119.8	123.8
20..	50.1	54.2	58.3	62.4	66.5	70.6	74.7	78.8	83.0	87.1	91.2	95.3	99.4	103.5	107.6	111.7	115.8	120.0	124.1	128.2
21..	52.3	56.5	60.7	65.0	69.2	73.4	77.6	81.8	86.1	90.3	94.5	98.7	103.0	107.2	111.4	115.6	119.8	124.1	128.3	132.5
22..	54.5	58.8	63.2	67.5	71.8	76.2	80.5	84.8	89.2	93.5	97.8	102.2	106.5	110.8	115.2	119.5	123.8	128.2	132.5	136.8
23..	56.7	61.2	65.6	70.1	74.5	79.0	83.4	87.8	92.3	96.7	101.2	105.6	110.1	114.5	119.1	123.4	127.8	132.3	136.7	141.2
24..	59.0	63.5	68.1	72.6	77.2	81.7	86.3	90.8	95.4	100.0	104.5	109.1	113.6	118.2	122.7	127.3	131.8	136.4	141.0	145.5

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 9-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3..	13.0	15.3	17.6	20.0	22.3	24.6	27.0	29.3	31.6	34.0	36.3	38.6	41.0	43.3	45.6	48.0	50.3	52.6	55.0	57.3
4..	15.3	17.7	20.2	22.6	25.1	27.5	30.0	32.4	34.8	37.3	39.7	42.2	44.6	47.1	49.5	52.0	54.4	56.8	59.3	61.7
5..	17.6	20.2	22.7	25.3	27.8	30.4	33.0	35.5	38.1	40.6	43.2	45.7	48.3	50.8	53.4	56.0	58.5	61.1	63.6	66.2
6..	20.0	22.6	25.3	28.0	30.6	33.3	36.0	38.6	41.3	44.0	46.6	49.3	52.0	54.6	57.3	60.0	63.5	65.4	68.0	70.6
7..	22.3	25.1	27.8	30.6	33.4	36.2	39.0	41.7	44.5	47.3	50.1	52.8	55.6	58.4	61.2	64.0	66.7	69.5	72.3	75.1
8..	24.6	27.5	30.4	33.3	36.2	39.1	42.0	44.8	47.7	50.6	53.5	56.4	59.3	62.2	65.1	68.0	70.8	73.7	77.6	79.5
9..	27.0	30.0	33.0	36.0	39.0	42.0	45.0	48.0	51.0	54.0	57.0	60.0	63.0	66.0	69.0	72.0	75.0	78.0	81.0	84.0
10..	29.3	32.4	35.5	38.6	41.7	44.8	48.0	52.0	54.2	57.3	60.4	63.5	66.6	69.7	72.8	76.0	79.1	82.2	85.3	88.4
11..	31.6	34.8	38.1	41.3	44.5	47.7	51.0	54.2	57.4	60.6	63.8	67.1	70.3	73.5	76.7	80.0	83.2	86.4	89.6	92.8
12..	34.0	37.3	40.6	44.0	47.3	50.6	54.0	57.3	60.6	64.0	67.3	70.6	74.0	77.3	80.6	84.0	87.3	90.6	94.0	97.3
13..	36.3	39.7	43.2	46.6	50.1	53.5	57.0	60.4	63.8	67.3	70.7	74.2	77.6	81.1	84.5	88.0	91.4	94.8	98.3	101.7
14..	38.6	42.2	45.7	49.3	52.8	56.4	60.0	63.5	67.1	70.6	74.2	77.7	81.3	84.8	88.4	92.0	95.5	99.1	102.6	106.2
15..	41.0	44.6	48.3	52.0	55.6	59.3	63.0	66.6	70.3	74.0	77.6	81.3	85.0	88.6	92.3	96.0	99.6	103.3	107.0	111.6
16..	43.3	47.1	50.8	54.6	58.4	62.2	66.0	69.7	73.5	77.3	81.1	84.8	88.6	92.4	96.2	100.0	103.7	107.5	111.3	115.1
17..	45.6	49.5	53.4	57.3	61.2	65.1	69.0	72.8	76.7	80.6	84.5	88.4	92.3	96.2	100.4	104.0	107.8	111.7	115.6	119.5
18..	48.0	52.0	56.0	60.0	64.0	68.0	72.0	76.0	80.0	84.0	88.0	92.0	96.0	100.0	104.0	108.0	112.0	116.0	120.0	124.0
19..	50.3	54.4	58.5	62.6	66.7	70.8	78.0	79.1	83.2	87.3	91.4	95.5	99.6	103.7	107.8	112.0	116.1	120.2	124.3	128.4
20..	52.6	56.8	61.1	65.3	69.5	73.7	78.0	82.2	86.4	90.6	94.8	99.1	103.3	107.5	111.7	116.0	120.2	124.4	128.6	132.8
21..	55.0	59.3	63.6	68.0	72.3	76.6	81.0	85.3	89.6	94.0	98.3	102.6	107.0	111.3	115.6	120.0	124.3	128.6	134.3	137.3
22..	57.3	61.7	66.2	70.6	75.1	79.5	84.0	88.4	92.8	97.3	101.7	106.2	111.6	115.1	121.5	124.0	128.4	132.8	137.3	141.7
23..	59.6	64.2	68.7	73.3	77.8	82.4	87.0	91.5	95.1	100.6	105.2	109.7	114.3	118.8	123.4	128.0	132.5	137.0	141.6	146.2
24..	62.0	66.6	71.3	76.0	80.6	85.3	90.0	94.6	99.3	104.0	108.6	113.3	118.0	122.6	127.3	132.0	136.6	141.3	146.0	150.6

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 9.6-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3..	13.6	16.1	18.5	21.0	23.4	25.8	28.3	30.7	33.2	35.6	38.1	40.5	43.0	45.4	47.8	50.3	52.7	55.2	57.6	60.1
4..	16.1	18.6	21.2	23.7	26.3	28.8	31.4	34.0	36.5	39.1	41.6	44.2	46.7	49.3	51.8	54.4	57.0	59.5	62.1	64.6
5..	18.5	21.2	23.8	26.5	29.2	31.8	34.5	37.2	39.8	42.5	45.2	47.8	50.5	53.2	55.8	58.5	61.2	63.8	66.5	69.2
6..	21.0	23.7	26.5	29.3	32.1	34.8	37.6	40.4	43.2	46.0	48.7	51.5	54.3	57.1	59.8	62.6	65.4	68.2	71.0	73.7
7..	23.4	26.3	29.2	32.1	35.0	37.8	40.7	43.6	46.5	49.4	52.3	55.2	58.1	61.0	63.8	66.7	69.6	72.5	75.4	78.3
8..	25.8	28.8	31.8	34.8	37.8	40.8	43.8	46.8	49.8	52.8	55.8	58.8	61.8	64.8	67.8	70.8	73.8	76.8	79.8	82.8
9..	28.3	31.4	34.5	37.6	40.7	43.8	47.0	50.1	53.2	56.3	59.4	62.5	65.6	68.7	71.8	75.0	78.1	81.2	84.3	87.4
10..	30.7	34.0	37.2	40.4	43.6	46.8	50.1	53.3	56.5	59.7	63.0	66.2	69.4	72.6	75.8	79.1	82.3	85.5	88.7	92.0
11..	33.2	36.5	39.8	43.2	46.5	49.8	53.2	56.5	59.8	63.2	66.5	69.8	73.2	76.5	79.8	83.2	86.5	89.8	93.2	96.5
12..	35.6	39.1	42.5	46.0	49.4	52.8	56.3	59.7	63.2	66.5	70.1	73.5	77.0	80.4	83.8	87.3	90.7	94.2	97.6	101.1
13..	38.1	41.6	45.2	48.7	52.3	55.8	59.4	63.0	66.5	70.1	73.6	77.2	80.7	84.3	87.8	91.4	95.0	98.5	102.1	105.6
14..	40.5	44.2	47.8	51.5	55.2	58.8	62.5	66.2	69.8	73.5	77.2	80.8	84.5	88.2	91.8	95.5	99.2	102.8	106.5	110.2
15..	43.0	46.7	50.5	54.3	58.1	61.8	65.6	69.4	73.2	77.0	80.7	84.5	88.3	92.1	95.8	99.6	103.4	107.2	111.0	114.7
16..	45.4	49.3	53.2	57.1	61.0	64.8	68.7	72.6	76.5	80.4	84.3	88.2	92.1	96.0	99.8	103.7	107.6	111.5	115.4	119.3
17..	47.8	51.8	55.8	59.8	63.8	67.8	71.8	75.8	79.8	83.8	87.8	91.8	95.8	99.8	103.8	107.8	111.8	115.8	119.8	123.8
18..	50.3	54.4	68.5	62.6	66.7	70.8	75.0	79.1	83.2	87.3	91.4	95.5	99.6	103.7	107.8	112.0	116.1	120.2	124.3	128.4
19..	52.7	57.0	61.2	65.4	69.6	73.8	78.1	82.3	86.5	90.7	95.0	99.0	103.4	107.6	111.8	116.1	120.3	124.5	128.7	133.0
20..	55.2	59.5	63.8	68.2	72.5	76.8	81.2	85.5	89.8	94.2	98.5	102.8	107.2	111.5	115.8	120.2	124.5	128.8	133.2	137.5
21..	57.6	62.1	66.5	71.0	75.4	79.8	84.3	88.7	93.2	97.6	102.1	106.5	111.0	115.4	119.8	124.3	128.7	133.2	137.6	142.1
22..	60.1	64.6	69.2	73.7	78.3	82.8	87.4	92.0	96.5	101.1	105.6	110.2	114.7	119.3	123.8	128.4	133.0	137.5	142.1	146.6
23..	62.5	67.2	71.8	76.5	81.2	85.8	90.5	95.2	99.8	104.5	109.2	113.8	118.5	123.2	127.8	132.5	137.2	141.8	146.5	151.2
24..	65.0	69.7	74.5	79.3	84.1	88.8	93.6	98.4	103.2	108.0	112.7	117.5	122.3	137.1	131.8	136.6	141.4	146.2	151.0	155.7

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 10-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3..	14.3	16.8	19.4	22.0	24.5	27.1	29.6	32.2	34.7	37.3	39.8	42.4	45.0	47.5	50.1	52.6	55.2	57.7	60.3	62.8
4..	16.8	19.5	22.2	24.8	27.5	30.2	32.8	35.5	38.2	40.8	43.5	46.2	48.8	51.5	54.2	56.8	59.5	62.2	64.8	67.5
5..	19.4	22.2	25.0	27.7	30.5	33.3	36.1	38.8	41.6	44.4	47.2	50.0	52.7	55.5	58.3	61.1	63.8	66.6	69.4	72.2
6..	22.0	24.8	27.7	30.6	33.5	36.4	39.3	42.2	45.1	48.0	50.8	53.7	56.6	59.5	62.4	65.3	68.2	71.1	74.0	76.8
7..	24.5	27.5	30.5	33.5	36.5	39.5	42.5	45.5	48.5	51.5	54.5	57.5	60.5	63.5	66.5	69.5	72.5	75.5	78.5	81.5
8..	27.1	30.2	33.3	36.4	39.5	42.6	45.7	48.8	52.0	55.1	58.2	61.3	64.4	67.5	70.6	73.7	76.8	80.0	83.1	86.2
9..	29.6	32.8	36.1	39.3	42.5	45.7	49.0	52.2	55.4	58.6	61.8	65.1	68.3	71.5	74.7	78.0	81.2	84.4	87.6	90.8
10..	32.3	35.5	38.8	42.2	45.5	48.8	52.2	55.5	58.8	62.2	65.5	68.8	72.2	75.5	78.8	82.2	85.5	88.8	92.2	95.5
11..	34.7	38.2	41.6	45.1	48.5	52.0	55.4	58.8	62.3	65.7	69.2	72.6	76.1	79.5	83.0	86.4	89.8	93.3	96.7	100.2
12..	37.3	40.8	44.4	48.0	51.5	55.1	58.6	62.2	65.7	69.3	72.8	76.4	80.0	83.5	87.1	90.6	94.2	97.7	101.3	104.8
13..	39.8	43.5	47.2	50.8	54.5	58.2	61.8	65.5	69.2	72.8	76.5	80.2	83.8	87.5	91.2	94.8	98.5	102.2	105.8	109.5
14..	42.4	46.2	50.0	53.7	57.5	61.3	65.1	68.8	72.6	76.4	80.2	84.0	87.7	91.5	95.3	99.1	102.8	106.6	110.4	114.2
15..	45.0	48.8	52.7	56.6	60.5	64.4	68.3	72.2	76.1	80.0	83.8	87.7	91.6	95.5	99.4	103.3	107.2	111.1	115.0	118.8
16..	47.5	51.5	55.5	59.5	63.5	67.5	71.5	75.5	79.5	83.5	87.5	91.5	95.5	99.5	103.5	107.5	111.5	115.5	119.5	123.5
17..	50.1	54.2	58.3	62.4	66.5	70.6	74.7	78.8	83.0	87.1	91.2	95.3	99.4	103.5	107.6	111.7	115.8	120.0	124.1	128.2
18..	52.6	56.8	61.1	65.3	69.5	73.7	78.0	82.2	86.4	90.6	94.8	99.1	103.3	107.5	111.7	116.0	120.2	124.4	128.6	132.8
19..	55.2	59.5	63.8	68.2	72.5	76.8	81.2	85.5	89.3	94.2	98.5	102.8	107.2	111.5	115.8	120.2	124.5	128.8	133.2	137.5
20..	57.7	62.2	66.6	71.1	75.5	80.0	84.4	88.8	93.3	97.7	102.2	106.6	111.1	115.5	120.0	124.4	128.8	133.3	137.7	142.2
21..	60.3	64.8	69.4	74.0	78.5	83.1	87.6	92.2	96.7	101.3	105.8	110.4	115.0	119.5	124.1	128.6	133.2	137.7	142.3	146.8
22.	62.8	67.5	72.2	76.8	81.5	86.2	90.8	95.5	100.2	104.8	109.5	114.2	118.8	123.5	128.2	132.8	137.5	142.2	146.8	151.5
23..	65.4	70.2	75.0	79.7	84.5	89.3	94.1	98.8	103.6	108.4	113.2	118.0	122.7	127.5	132.3	137.1	141.8	146.6	151.4	156.2
24..	68.0	72.8	77.7	82.6	87.5	92.4	97.3	102.2	107.1	112.1	114.8	116.6	121.7	131.5	136.4	141.3	146.2	151.1	156.0	160.8

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 10.6-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3.	15.0	17.6	20.3	23.0	25.6	28.3	31.0	33.6	36.3	39.0	41.6	44.3	47.0	49.6	52.3	55.0	57.6	60.3	63.0	55.6
4.	17.6	20.4	23.2	26.0	28.7	31.5	34.3	37.1	39.8	42.6	45.4	48.2	51.0	53.7	56.5	59.3	62.1	64.8	67.6	70.4
5.	20.3	23.2	26.1	29.0	31.8	34.7	37.6	40.5	43.4	46.3	49.2	52.1	55.0	57.8	60.7	63.6	66.5	69.4	72.3	75.2
6.	23.0	26.0	29.0	32.0	35.0	38.0	41.0	44.0	47.0	50.0	53.0	56.0	59.0	62.0	65.0	68.0	71.0	74.0	77.0	80.0
7.	25.6	28.7	31.8	35.0	38.1	41.2	44.3	47.4	50.5	53.6	56.7	59.8	63.0	66.1	69.2	72.3	75.4	78.5	81.6	84.7
8.	28.3	31.5	34.7	38.0	41.2	44.4	47.6	50.8	54.1	57.3	60.5	63.7	67.0	70.2	73.4	76.6	79.8	83.1	86.3	89.5
9.	31.0	34.3	37.6	41.0	44.3	47.6	51.0	54.3	57.6	61.0	64.3	67.6	71.0	74.3	77.6	81.0	84.3	87.6	91.0	94.3
10.	33.6	37.1	40.5	44.0	47.4	50.8	54.3	57.7	61.2	64.6	68.1	71.5	75.0	78.4	81.8	85.3	88.7	92.2	95.6	99.1
11.	36.3	39.8	43.4	47.0	50.5	54.1	57.6	61.2	64.7	68.3	71.8	75.4	79.0	82.5	86.1	89.6	93.2	96.7	100.3	103.8
12.	39.0	42.6	46.3	50.0	53.6	57.3	61.0	64.6	68.3	72.0	75.6	79.3	83.0	86.6	90.3	94.0	97.6	101.3	105.0	108.6
13.	41.6	45.4	49.2	53.0	56.7	60.5	64.3	68.1	71.8	75.6	79.4	83.2	87.0	90.7	94.5	98.3	102.1	105.8	109.6	113.4
14.	44.3	48.2	52.1	56.0	59.8	63.7	67.6	71.5	75.4	79.3	83.2	87.1	91.0	94.8	98.7	102.6	106.5	110.4	114.3	118.2
15.	47.0	51.0	55.0	59.0	63.0	67.0	71.0	75.0	79.0	83.0	87.0	91.0	95.0	99.0	103.0	107.0	111.0	115.0	119.0	123.0
16.	49.6	53.7	57.8	62.0	66.1	70.2	74.3	78.4	82.5	86.6	90.7	94.8	99.0	103.1	107.2	111.3	115.4	119.5	123.6	127.7
17.	52.3	56.5	60.7	65.0	69.2	73.4	77.6	81.8	86.1	90.3	94.5	98.7	103.0	107.2	111.4	115.6	119.8	124.1	128.3	132.5
18.	55.0	59.3	63.6	68.0	72.3	76.6	81.0	85.3	89.6	94.0	98.3	102.6	107.0	111.3	115.6	120.0	124.3	128.6	133.0	137.3
19.	57.6	62.1	66.5	71.0	75.4	79.8	84.3	88.7	93.2	97.6	102.1	106.5	111.0	115.4	119.8	124.3	128.7	133.2	137.6	142.1
20.	60.3	64.8	69.4	74.0	78.5	83.1	87.6	92.2	96.7	101.3	105.8	110.4	115.0	119.5	124.1	128.6	133.2	137.7	142.3	146.8
21.	63.0	67.6	72.3	77.0	81.6	86.3	91.0	95.6	100.3	105.0	109.6	114.3	119.0	123.6	128.3	133.0	137.6	142.3	147.0	151.6
22.	55.6	70.4	75.2	80.0	84.7	89.5	94.3	99.1	103.8	108.6	113.4	118.2	123.0	127.7	132.5	137.3	142.1	146.8	151.6	156.4
23.	68.3	73.2	78.1	83.0	87.8	92.7	97.6	102.5	107.4	112.3	117.2	122.1	127.0	131.8	136.7	141.6	146.5	151.4	156.3	161.2
24.	71.0	76.0	81.0	86.0	91.0	96.0	101.0	106.0	111.0	116.0	121.0	126.0	131.0	136.0	141.0	146.0	151.0	156.0	161.0	166.0

The amount indicated includes side walls and ceilings

NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 11-FOOT CEILINGS

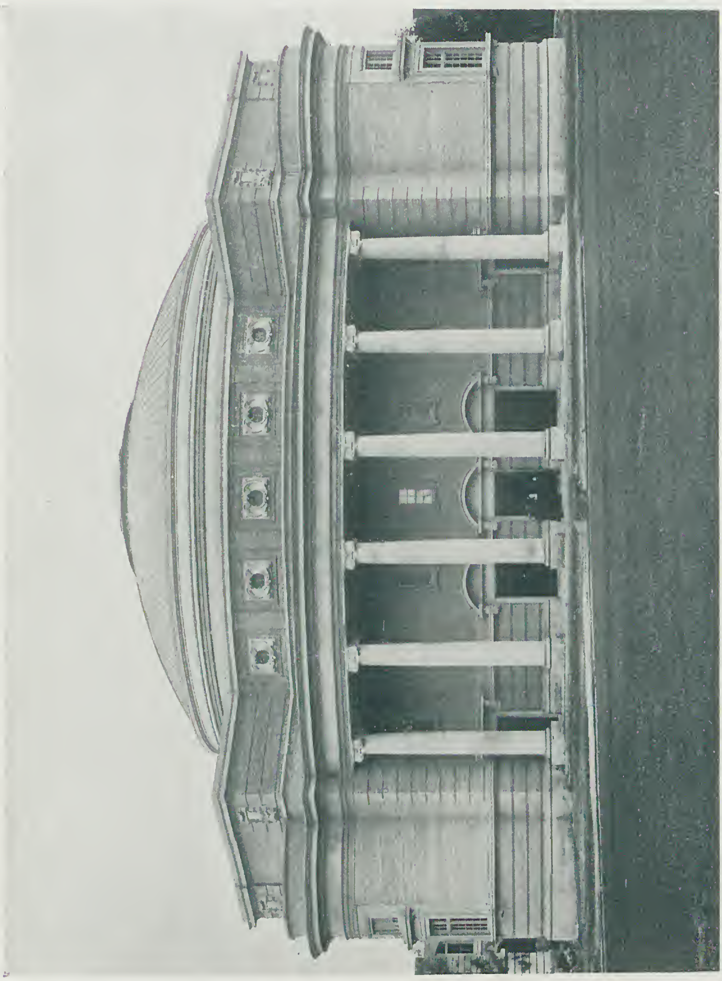
	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3..	15.6	18.4	21.2	24.0	26.7	29.5	32.3	35.1	37.8	40.6	43.4	46.2	49.0	51.7	54.5	57.3	60.1	62.8	65.6	68.4
4..	18.4	21.3	24.2	27.1	30.0	32.8	35.7	38.6	41.5	44.4	47.3	50.2	53.1	56.0	58.8	61.7	64.6	67.5	70.4	73.6
5..	21.2	24.2	27.2	30.2	33.2	36.2	39.2	42.2	45.2	48.2	51.2	54.2	57.2	60.2	63.2	66.2	69.2	72.2	75.2	78.2
6..	24.0	27.1	30.2	33.3	36.4	39.5	42.6	45.7	48.8	52.0	55.1	58.2	61.3	64.4	67.5	70.6	73.7	76.8	80.0	83.1
7..	26.7	30.0	33.2	36.4	39.6	42.8	46.1	49.3	52.5	55.7	59.0	62.2	65.4	68.6	71.8	75.1	78.3	81.5	84.7	88.0
8..	29.5	32.8	36.2	39.5	42.8	46.2	49.5	52.8	56.2	59.5	62.8	66.2	69.5	72.8	76.2	79.5	82.8	86.2	89.5	92.8
9..	32.3	35.7	39.2	42.6	46.1	49.5	53.0	56.4	59.8	63.3	66.7	70.2	73.6	77.1	80.5	84.0	87.4	90.8	94.3	96.7
10..	35.1	38.6	42.2	45.7	49.3	52.8	56.4	60.0	63.5	67.1	70.6	74.2	77.7	81.3	84.8	88.4	92.0	95.5	99.1	102.6
11..	37.8	41.5	45.2	48.8	52.5	56.2	59.8	63.5	67.2	70.8	74.5	78.2	81.8	85.5	89.2	92.8	96.5	100.2	103.8	107.5
12..	40.6	44.4	48.2	52.0	55.7	59.5	63.3	67.1	70.8	74.6	78.4	82.2	86.0	89.7	93.5	97.3	101.1	104.8	108.6	112.4
13..	43.4	47.3	51.2	55.1	59.0	62.8	66.7	70.6	74.5	78.4	82.3	86.2	90.1	94.0	97.8	101.7	105.6	109.5	113.4	117.3
14..	46.2	50.2	54.2	58.2	62.2	66.2	70.2	74.2	78.2	82.2	86.2	90.2	94.2	98.2	102.2	106.2	110.2	114.2	118.2	122.2
15..	49.0	53.1	57.2	61.3	65.4	69.5	73.6	77.7	81.8	86.0	90.1	94.2	98.3	102.4	106.5	110.6	114.7	118.8	123.0	127.1
16..	51.7	56.0	60.2	64.4	68.6	72.8	77.1	81.3	85.5	89.7	94.0	98.2	102.4	106.6	110.8	115.1	119.3	123.5	127.7	132.0
17..	54.5	58.8	63.2	67.5	71.8	76.2	80.5	84.8	89.2	93.5	97.8	102.2	106.5	110.8	115.2	119.5	123.8	128.2	132.5	136.8
18..	57.3	61.7	66.2	70.6	75.1	79.5	84.0	88.4	92.8	97.3	101.7	106.2	110.6	115.1	119.5	124.0	128.4	132.8	137.3	141.7
19..	60.1	64.6	69.2	73.7	78.3	82.8	87.4	92.0	96.5	101.1	105.6	110.2	114.7	119.3	123.8	128.4	133.0	137.5	142.1	146.6
20..	62.8	67.5	72.2	76.8	81.5	86.2	90.8	95.5	100.2	104.8	109.5	114.2	118.8	123.5	128.2	132.8	137.5	142.2	146.8	151.5
21..	65.6	70.4	75.2	80.0	84.7	89.5	94.3	99.1	103.8	108.6	113.4	118.2	123.0	127.7	132.5	137.3	142.1	146.8	151.6	156.4
22..	68.4	73.3	78.2	83.1	88.0	92.8	97.7	102.6	107.5	112.4	117.3	122.2	127.1	132.0	136.8	141.7	146.6	151.5	156.4	161.3

The amount indicated includes side walls and ceilings

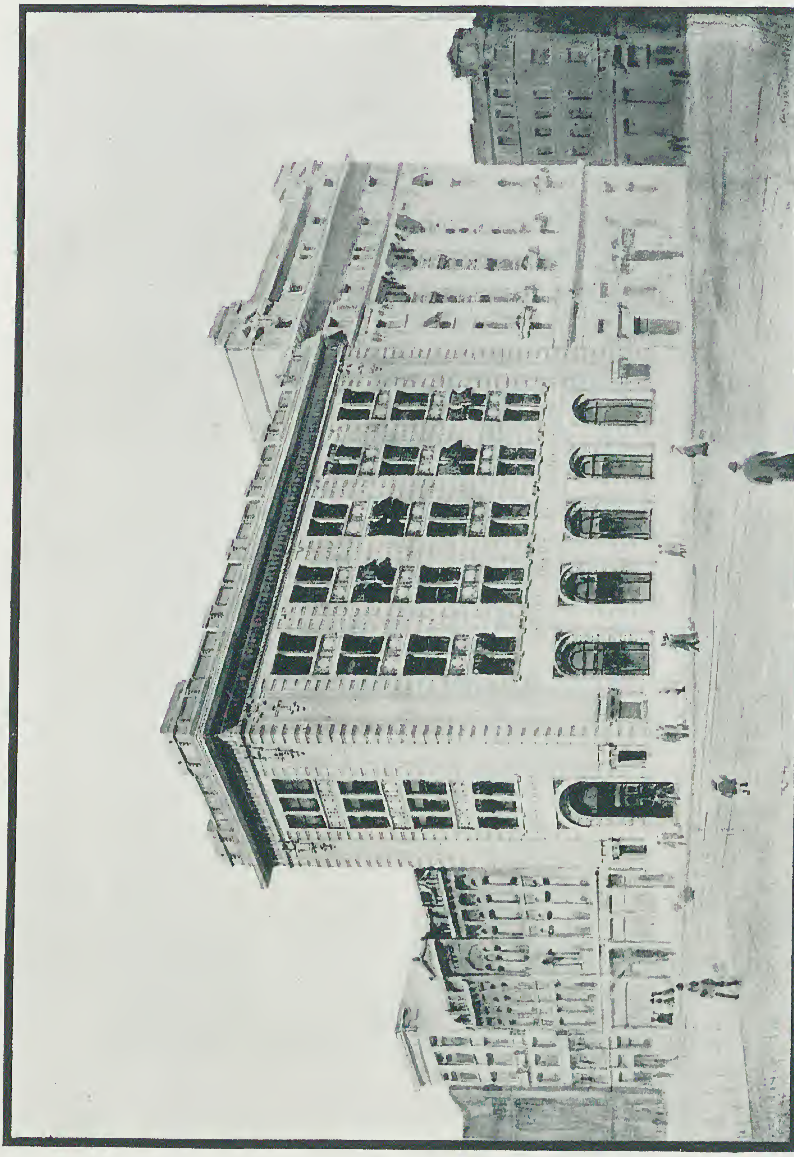
NUMBER OF SQUARE YARDS AND FEET IN ROOMS WITH 12-FOOT CEILINGS

	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
3.	17.0	20.0	23.0	26.0	29.0	32.0	35.0	38.0	41.0	44.0	47.0	50.0	53.0	56.0	59.0	62.0	65.0	68.0	71.0	74.0
4.	20.0	23.1	26.2	29.3	32.4	35.5	38.6	41.7	44.8	48.0	51.1	54.2	57.3	60.4	63.5	66.6	69.7	72.8	76.0	79.1
5.	23.0	26.2	29.4	32.6	35.8	39.1	42.3	45.5	48.7	52.0	55.2	58.4	61.6	64.8	68.1	71.3	74.5	77.7	81.0	84.2
6.	26.0	29.3	32.6	36.0	39.3	42.6	46.0	49.3	52.6	56.0	59.3	62.6	66.0	69.3	72.6	76.0	79.3	82.6	86.0	89.3
7.	29.0	32.4	35.8	39.3	42.7	46.2	49.6	53.1	56.5	60.0	63.4	66.8	70.3	73.7	77.2	80.6	84.4	87.5	91.0	94.4
8.	32.0	35.5	39.1	42.6	46.2	49.7	53.3	56.8	60.4	64.0	67.5	71.1	74.6	78.2	81.7	85.3	88.8	92.4	96.0	99.5
9.	35.0	38.6	42.3	46.0	49.0	53.3	57.0	60.6	64.3	68.0	71.6	75.3	79.0	82.6	86.3	90.0	93.6	97.3	101.0	104.6
10.	38.0	41.7	45.5	49.3	53.0	56.8	60.6	64.4	68.2	72.0	75.7	79.5	83.3	87.1	90.8	94.6	98.4	102.2	106.0	109.7
11.	41.0	44.8	48.7	52.6	56.5	60.4	64.3	68.2	72.1	76.0	79.8	83.7	87.6	91.5	95.4	99.3	103.2	107.1	111.0	114.8
12.	44.0	48.0	52.0	56.0	60.0	64.0	68.0	72.0	76.0	80.0	84.0	88.0	92.0	96.0	100.0	104.0	108.0	112.0	116.0	120.0
13.	47.0	51.1	55.2	59.3	63.4	67.5	71.6	75.7	79.8	84.0	88.1	92.2	96.3	100.4	104.5	108.6	112.7	116.8	121.0	125.1
14.	50.0	54.2	58.4	62.6	66.8	71.1	75.3	79.5	83.7	88.0	92.2	96.4	100.6	104.8	109.1	113.3	117.5	121.7	126.0	130.2
15.	53.0	57.3	61.6	66.0	70.3	74.6	79.0	83.3	87.6	92.0	96.3	100.6	105.0	109.3	113.6	118.0	122.3	126.6	131.0	135.3
16.	56.0	60.4	64.8	69.3	73.7	78.2	82.6	87.1	91.5	96.0	100.4	104.8	109.3	113.7	118.2	122.6	127.1	131.5	136.0	140.4
17.	59.0	63.5	68.1	72.6	77.2	81.7	86.3	90.8	95.4	100.0	104.5	109.1	113.6	118.2	122.7	127.3	131.8	136.4	141.0	145.5
18.	62.0	66.6	71.3	76.0	80.6	85.3	90.0	94.6	99.3	104.0	108.6	113.3	118.0	122.6	127.3	132.0	136.6	141.3	146.0	150.6
19.	65.0	69.7	74.5	79.3	84.1	88.8	93.6	98.4	103.2	108.0	112.7	117.5	122.3	127.1	131.8	136.6	141.4	146.2	151.0	155.7
20.	68.0	72.8	77.7	82.6	87.5	92.4	97.3	102.2	107.1	112.0	116.8	121.7	126.6	131.5	136.4	141.3	146.2	151.1	156.0	160.8
21.	71.0	76.0	81.0	86.0	91.0	96.0	101.0	106.0	111.0	116.0	121.0	126.0	131.0	136.0	141.0	146.0	151.0	156.0	161.0	166.0
22.	74.0	79.1	84.2	89.3	94.4	99.5	104.6	109.7	114.8	120.0	125.1	130.2	135.3	140.4	145.5	150.6	155.7	160.8	166.0	171.1

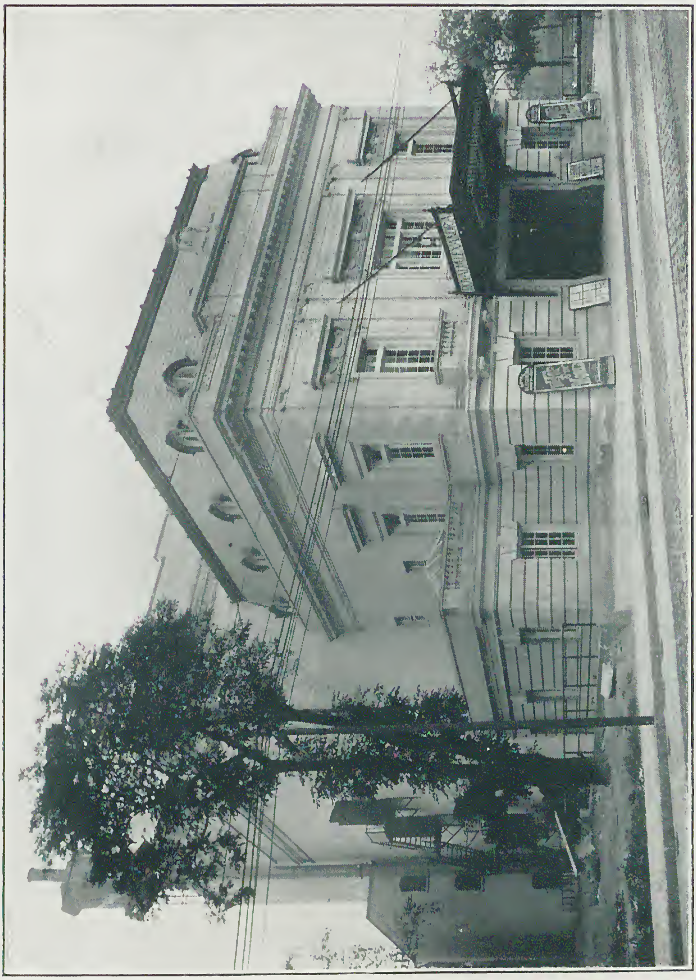
The amount indicated includes side walls and ceilings



Convocation Hall, University of Toronto. Darling and Pearson, Architects.
In this fine building as well as most of the other modern buildings of this group, "Steelcrete" Reinforcement and Lath are used.



The new Union Bank Building, Toronto.
Messrs. Darling and Pearson, Architects. Messrs. H. C. Hitch & Co., Ltd., Contractors
"Steelcrete" Reinforcement and Lath.



Royal Alexandra Theatre, Toronto. Jno. M. Lyle, Esq., Architect.
Reinforced and Fireproofed with " Steelcrete."

Royal Archives Building, Ottawa. D. Ewart, Architect.
"Steelcrete" Reinforcement and Lath.

ADDENDA

ON the following pages brief mention is made of the several other lines manufactured by STEEL AND RADIATION LIMITED. More complete information on each subject will be found in the Catalogues, Booklets, etc., issued on the respective materials.

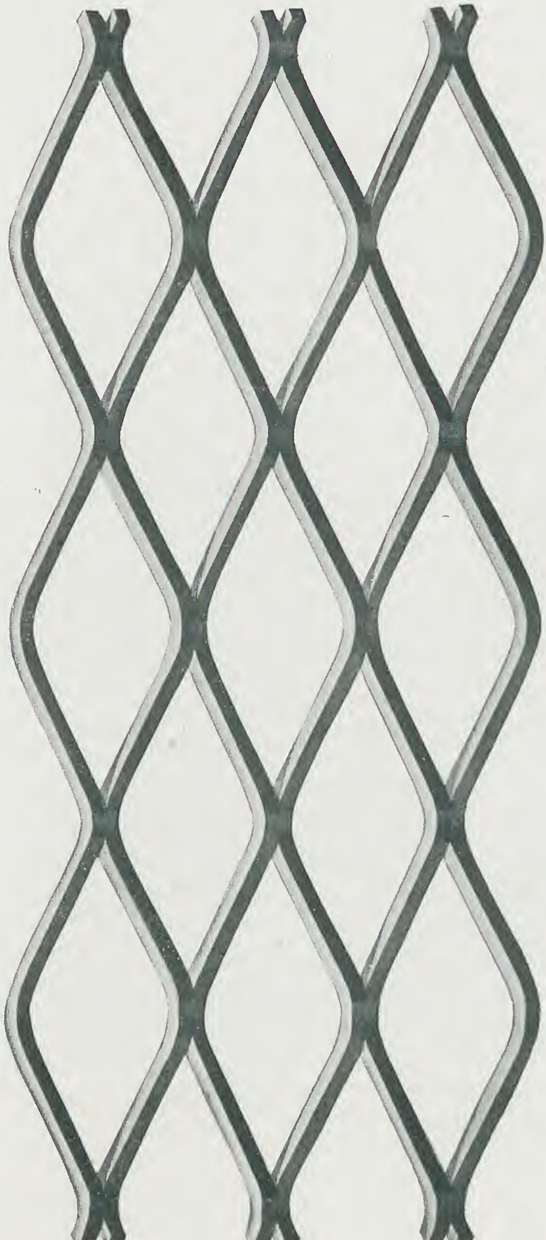
GENERAL USES OF EXPANDED METAL

The public generally do not appreciate the many and varied uses to which Expanded Metal can be put and for which it is unequalled by many of the materials more commonly used.

It is superior to woven fabrics on general principles. Mainly, because the strands being rigidly joined at each intersection prevents spreading of the mesh and subsequent "bagging" and looseness.

The ingenuity of manufacturers, etc., is constantly devising new utilities for this very adaptable product. Being fabricated from a soft, specially annealed steel, "Steelcrete" Expanded Metal sheets may be readily bent to a right angle without impairing the strength; also it may be fashioned with ease to any curve desirable. "Steelcrete" Expanded Metal can be bent back and forth on itself a score of times without breaking.

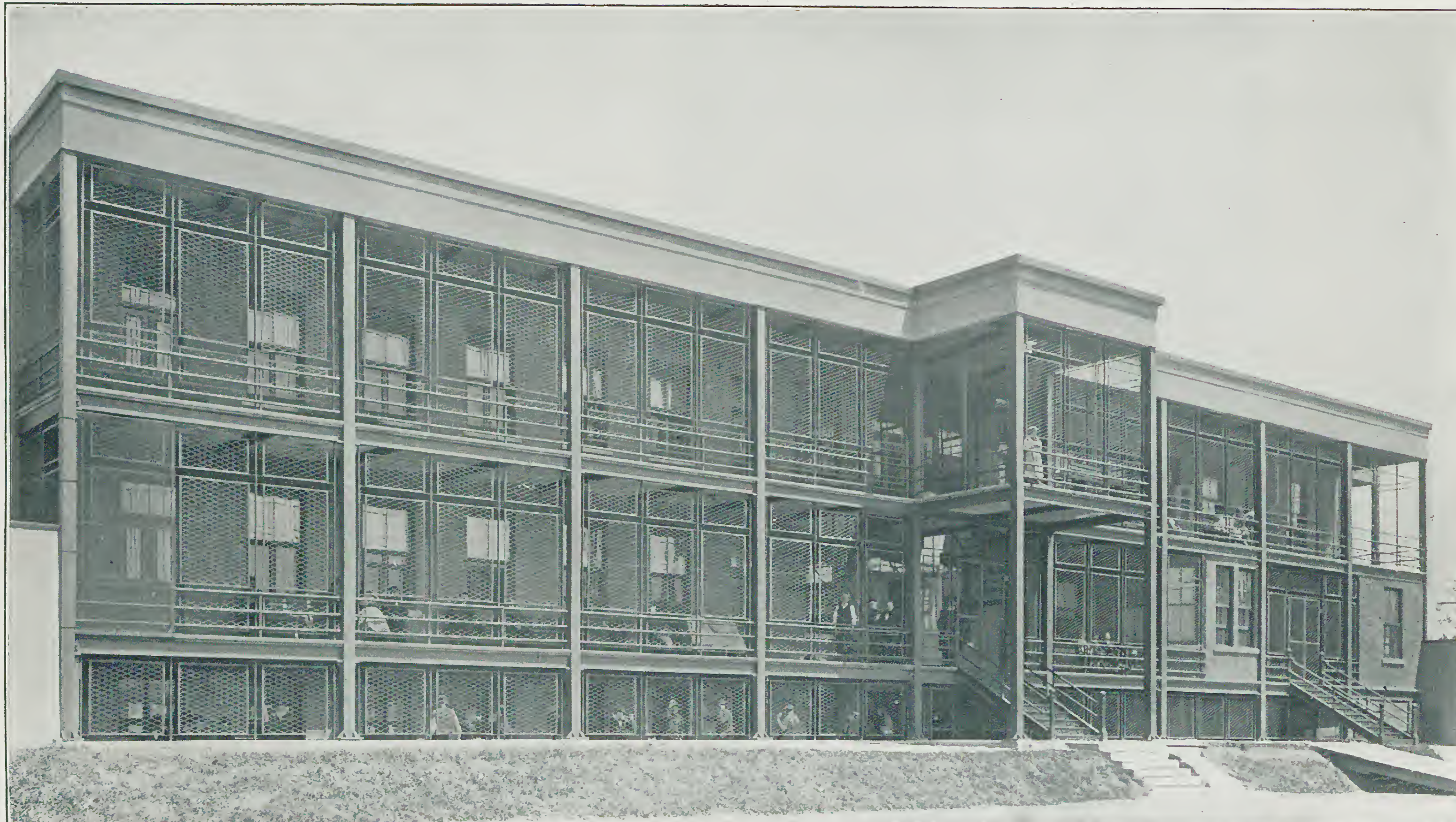
The desirability of a sheet of mesh which may be used without rim, frame or border, and which may be cut to any variety of shape, is apparent. Expanded Metal Sheets may be had in 3 in., 2 in. and 1 in. meshes.



Actual size of our 1 in. x 2 in. Mesh, cut in 14 and 16 gauge. Metal. For other sizes see page 7 and 11.

OF USES A FEW

Window Guards
Wagon Guards
Railings
Wicket Screens
Ash Sifters
Gravel Screens
Stove Gratings
Furnace Insulation
Lockers
Waste Paper Baskets
Desk Trays
Elevator Enclosures
Stair Enclosures
Tool Room Partitions
Store Room Partitions
Tree Boxes
Flower Guards
Fences



The Dominion Government Immigration Department Trachoma Detention Hospital, Quebec.
Note:—"Steelcrete" Expanded Metal Balcony Guards—Neat, Light and Strong.

THE ABOVE ILLUSTRATION

indicates one out of over 2,000 residences in Toronto—alone—similarly treated, and gives an idea of the attractive appearance imparted by utilizing **"Steelcrete" Expanded Metal** for the verandah. Your windows are secure from stone throwing; no animals can intrude; no obstruction is presented to light, while—not being woven—the steel mesh work must be hacked to pieces laboriously by some heavy tool before entrance can be forced. As for installation, the expense of a frame is saved. The sheet is simply nailed or stapled to the woodwork and a neat batten or moulding completely hides the edges.

EXPANDED METAL LOCKERS

The general adaptability of Expanded Metal for many classes of interior fittings is amply demonstrated by its use in the manufacture of Lockers for gymnasiums, clubs, warehouses, factories, shops, car barns, etc.

The Expanded Metal Locker is rapidly replacing the wooden and the wire locker. It is superior in every way.

Expanded Metal Lockers afford **perfect ventilation** and are **easily cleaned**—simply wash out with a hose. They have the approval of all insurance companies. A lighted pipe carelessly left in a wooden locker may result in a serious fire. Expanded Metal Lockers are steel throughout.

These lockers are **neat** and **attractive** in appearance and **very strong**. The security of the contents is positive.

Made in standard sizes. Also can be made in any special size or style to suit requirements.

STANDARD SIZES

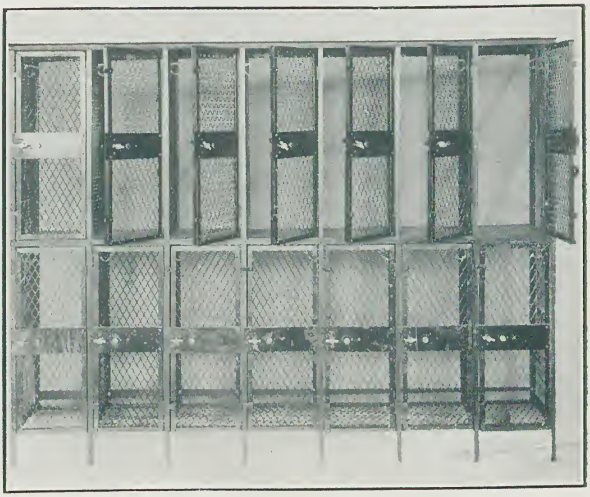
12″ x 12″ x 36″

15″ x 15″ x 36″

18″ x 18″ x 36″

Inside measurements of each locker.

6″ legs make total height 78″ over all.



Gymnasium Lockers (Double Tier), fitted with Hooks and Padlocks, Rim Locks, or Miller Keyless Locks. Finished with superior Japan or dipped in paint of any desired color.

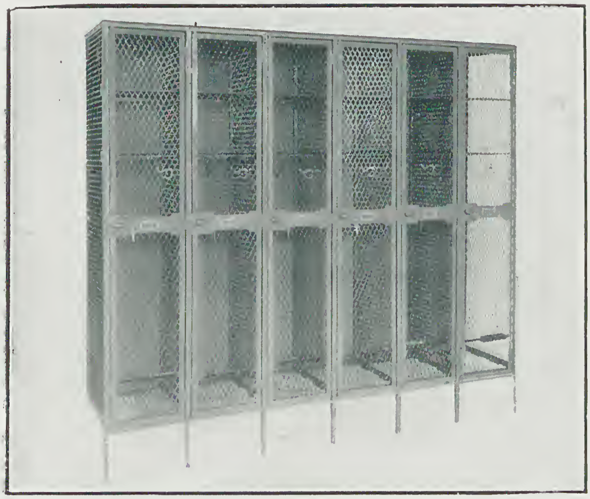
EXPANDED METAL LOCKERS

Standard Shop or Warehouse Locker

Fitted with one shelf and three hat and coat hooks, Padlock or Miller Keyless Lock.

Finished in Olive Green or any desired color with Expanded Metal or Sheet Steel partitions, ends, doors or bottoms.

Write giving space to be devoted to lockers and we will quote you for required number. The low price will surprise you.



STANDARD SIZES

12″ x 12″ x 66″

15″ x 15″ x 66″

18″ x 18″ x 66″

Inside measurements of each locker.

6″ legs make total height 72″.

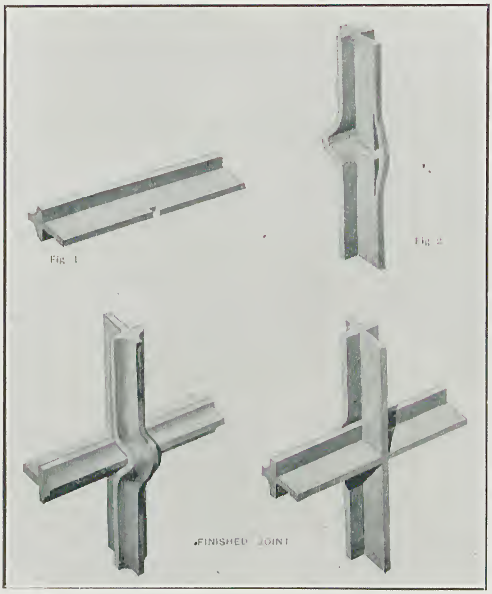
Doors finished with our 3 point catch cannot be pried open, being securely fastened top and bottom and centre.

Ask for special Locker Booklet and Prices.

FIREPROOF YOUR WINDOWS WITH "FENESTRA" STEEL SASH

And Protect Your Premises at Moderate Cost from Outside Conflagrations

In addition to its advantages from an insurance standpoint, "Fenestra" Steel Sash combines a light and handsome appearance with great rigidity and strength in any type of building. Full information in "Fenestra" Catalogue. Estimates cheerfully furnished.



The "Fenestra" Steel Sash is made in all sizes and can be built into brick, stone, steel or wooden buildings. Any area or style of ventilation may be used with "Fenestra" Steel Sash and owing to the small cross section of wrought steel bar, a minimum light obstruction is secured.

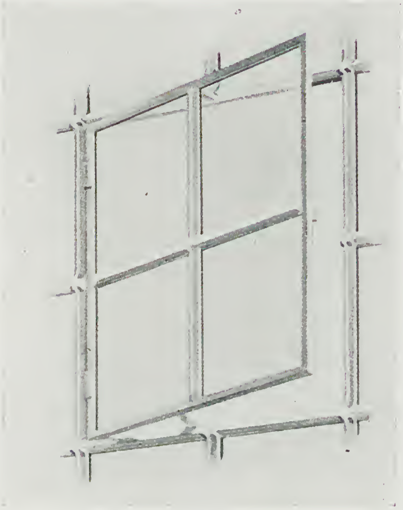
In the "Fenestra" joint, as can be seen by accompanying cuts, a small cross slot is made in one of the bars (Fig. 2) only sufficiently large to allow the flange of the other bar (Fig. 1) to pass through it.

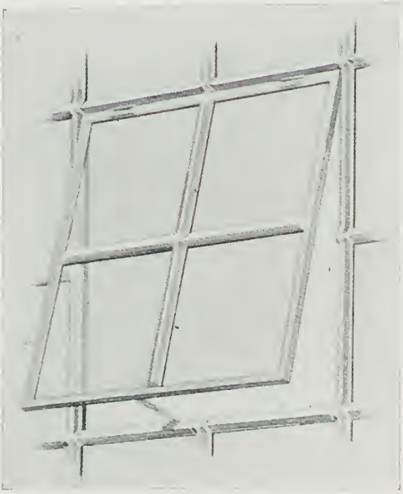
The inserted bar (Fig. 1) is only cut in one place, a small nick being made to allow of its being locked in position.

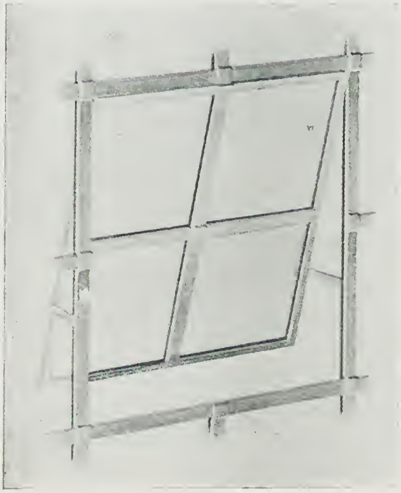
From this it will be seen that this allows the use of the lightest possible section of steel, making a great saving in weight of material and consequently in the cost of sash.

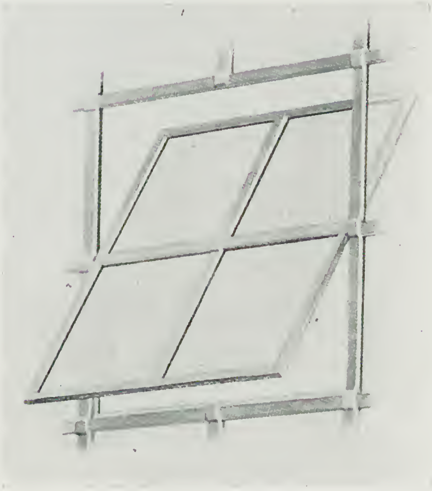
Our Catalogue F-2 contains full and complete illustrations and explanation of "Fenestra" Sash and Casements.

FENESTRA STEEL SASH VENTILATORS







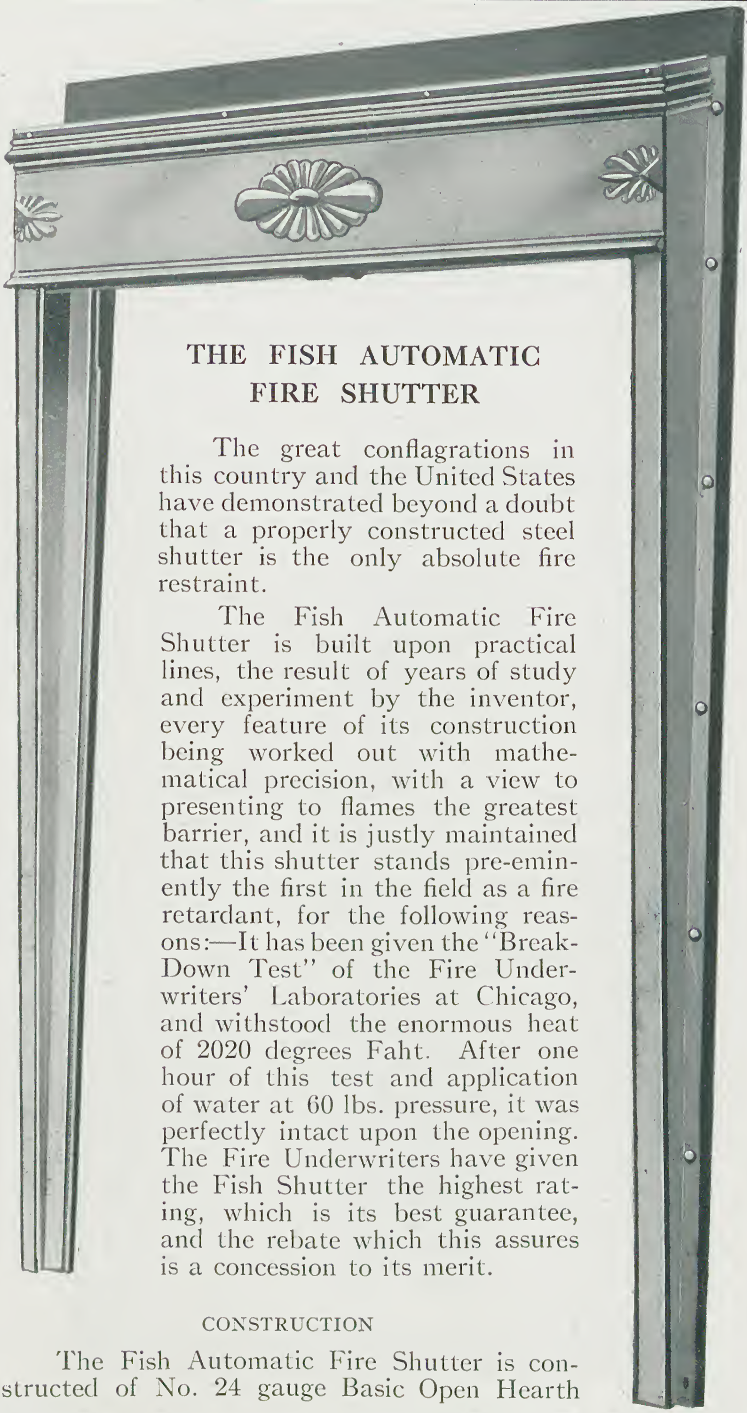


"CRITTALL'S" CASEMENTS

To those conversant with High Grade Hand Made Steel Casements, especially in Great Britain and on the Continent, the Crittall Manufacturing Company, Limited, of London, E.C., and Braintree, Essex, are well and favorably known as the makers of the very highest grade work. Our arrangements with Messrs. Crittall Manufacturing Co., Ltd., enable us to place these goods at the disposal of Canadian Architects and builders.

Our Steel Window experts are trained men who understand every phase of this rather complicated proposition, and we crave the opportunity of advising and consulting with architects or others who may be interested in Solid Steel Casements.

Our Catalogue F-2 deals more fully with the subject.



THE FISH AUTOMATIC FIRE SHUTTER

The great conflagrations in this country and the United States have demonstrated beyond a doubt that a properly constructed steel shutter is the only absolute fire restraint.

The Fish Automatic Fire Shutter is built upon practical lines, the result of years of study and experiment by the inventor, every feature of its construction being worked out with mathematical precision, with a view to presenting to flames the greatest barrier, and it is justly maintained that this shutter stands pre-eminently the first in the field as a fire retardant, for the following reasons:—It has been given the "Break-Down Test" of the Fire Underwriters' Laboratories at Chicago, and withstood the enormous heat of 2020 degrees Faht. After one hour of this test and application of water at 60 lbs. pressure, it was perfectly intact upon the opening. The Fire Underwriters have given the Fish Shutter the highest rating, which is its best guarantee, and the rebate which this assures is a concession to its merit.

CONSTRUCTION

The Fish Automatic Fire Shutter is constructed of No. 24 gauge Basic Open Hearth

THE FISH AUTOMATIC FIRE SHUTTER—*Continued*

Steel Sheets, heavily galvanized, in uniform sections or leaves 12 inches to the weather, two thicknesses of the steel being employed with a lining of asbestos, and having angle flanges at top and bottom of leaners, which adds rigidity to the surface of the shutter in the face of flame. Each section slides over the one above by means of iron bolts or rods running through brass grummeted holes in the flanges, and all are contained or telescoped into a weatherproof hood over the opening held in position by double levers, bound with a link fusible at a temperature of 155 degrees Faht. The instant the link fuses, the levers are released and the shutter drops in position over the opening, shutting off draught and forming a perfect steel barrier.

GOOD POINTS OF THE FISH AUTOMATIC FIRE SHUTTER

It is simple, having no springs or gears to get out of order.
It is positively automatic and reliable.
It shuts out no light or air.
It is out of the way, occupying no valuable space.
It needs no attention.
The first cost is the whole cost.
The rebate on your insurance premium will pay for installation.
It being heavily galvanized, will last indefinitely.
All movable joints are brass bushed, preventing corrosion.
It **drops** of its **own weight.**

Firemen, when obliged to force their way into a building protected by Fish Automatic Shutters, have simply to raise a section of shutter to insert the hose. This feature has appealed strongly to experienced Fire Chiefs to whom this shutter has been submitted.

The Fish Automatic Fire Shutter is particularly adapted for use on mullioned windows.

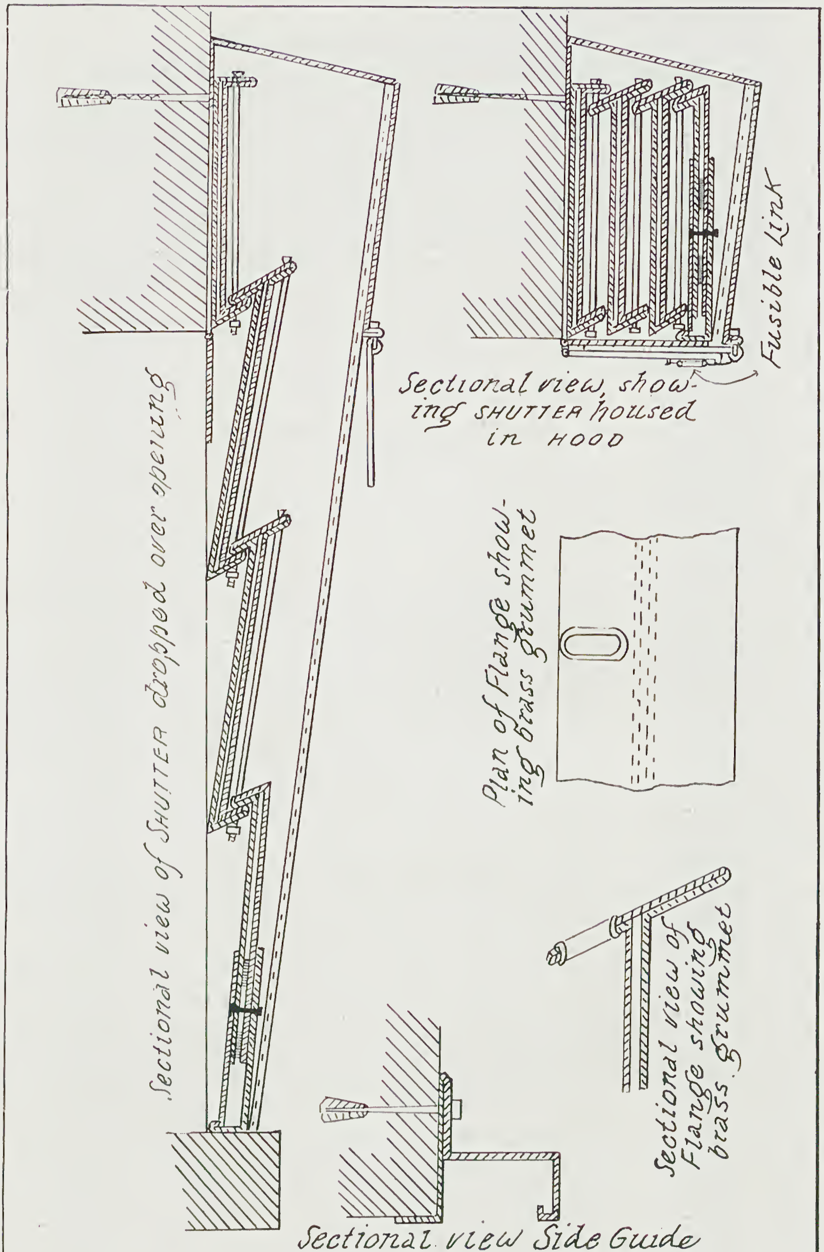
The architect will find this shutter a great benefit. He is not obliged to provide space for sliding doors, neither will he have to disfigure the building with swinging shutters which are unsightly and uncertain, as they depend upon human agency to close.

The Fish Automatic Shutter adds to the attractiveness of a building and is equally effective on exterior and interior installation.

Elevator openings are considered the worst of hazards, as they act as a conductor and allow fire to communicate from one floor to another. Owing to the construction of walls or lack of space in many instances, it is impossible to close them with ordinary shutters, but the Fish Automatic Shutter solves this problem.

When writing for quotation, please furnish the following information:

1st. Inside or outside installation.
2nd. Width of opening.
3rd. Height of opening at sides.
4th. Height of opening at centre, if arched.
5th. Height from top of opening to ceiling, if inside.
6th. If cased with wood, give width of casing, if inside.
7th. Of what material is wall.



FISH AUTOMATIC FIRE SHUTTER

FISH AUTOMATIC FIRE SHUTTER

KING RADIATORS

4 Column

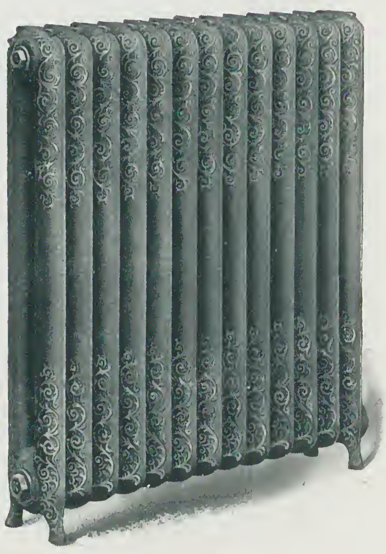
The **"King"** Radiator has for many years been favorably known for the excellence of its material and construction.

The sections are joined together with malleable **screw** nipples.

Each Radiator is tested and subjected to the most rigid inspection possible before it is allowed to leave our hands, so that we **guarantee** every Radiator not only against defect or leakage, but to contain the full amount of heating surface catalogued.

We make **"King"** Radiators in artistic styles of both plain and ornamental design and in all heights and widths, which are adaptable to any space.

If you are interested in Heating, write us for Catalogue.



2 Column

KING BOILERS

In this new Hot Water Boiler which we have just completed and placed on the market, is combined the result of years of experience, the employment of the best mechanics, and the greatest care in the selection of materials.

It contains a number of entirely new features and improvements.

Combustion Chambers and Water Ways

Special attention has been given to the design of the combustion chambers and water ways with the result that we can absolutely guarantee maximum heat from minimum fuel consumption.

Corrugated Fire Pot

The Corrugated Fire Pot greatly increases the surface area on which the fire acts and thinner water ways mean faster circulation.

"King" High Base Boiler

Grates and Shaking Apparatus

The shaking and dumping grate, however, is one of the most important features in the new "KING" Boiler. As will be seen by the accompanying cut, it is operated in the front, with handle which is always in position, and no stooping is necessary to shake it. To dump the grate, the handle is reversed.

The absence of bolts or pins in attaching the connecting bar to the grates, saves trouble and annoyance when parts require to be replaced.

If you are interested in either Hot Water or Steam Heating, write us and we will gladly give full information.

Get our Boiler and Radiator Catalogues.

SOUTHAM PRESS, LIMITED, TORONTO

"Steelcrete"
TRADE MARK

EXPANDED METAL LATH